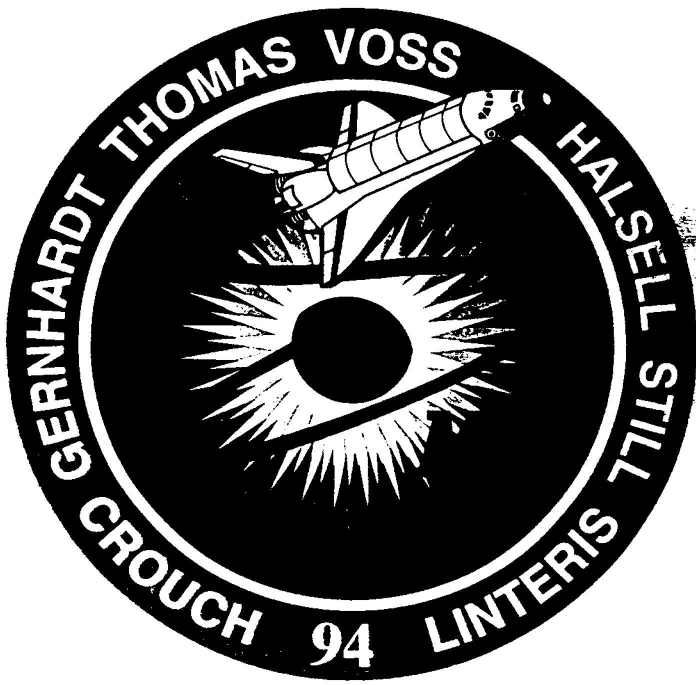
J97-21

National Aeronautics and Space Administration

SPACE SHUTTLE MISSION STS-94

PRESS KIT
July 1997



MICROGRAVITY SCIENCE LABORATORY-1 (MSL-1)

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COLUMBIA AND CREW READY FOR REFLIGHT OF MICROGRAVITY SCIENCES LABORATORY-1 PAYLOAD ON MISSION STS-94

Following a modified processing session at Kennedy Space Center, Space Shuttle Columbia will fly again in early July to complete the Microgravity Science Laboratory (MSL) flight which was cut short during the STS-83 mission in April because of a fuel cell problem.

The reflight of the MSL payload, is designated Mission STS-94, and will involve the same vehicle, crew and experiment activities as originally planned earlier this year. Columbia's crew will continue NASA's efforts to understand the subtle and complex phenomena associated with the influence of gravity in many aspects of daily life. The flight will involve the STS-94 crew spending more than two weeks in orbit as they conduct a variety of experiments to examine how various materials and liquids change and behave in the weightless environment of space.

The STS-94 crew will again be commanded by Jim Halsell, who will be making his fourth Shuttle flight. Susan Still is the pilot and will be making her second flight. There are three mission specialists on the flight. Janice Voss, making her fourth flight, is Mission Specialist-1 and is also the Payload Commander for STS-94. Mission Specialist-2 is Mike Gernhardt, making his third flight. Don Thomas is Mission Specialist-3 and is making his fourth flight. There are also two payload specialists serving on the STS-94 crew. Roger Crouch is Payload Specialist-1 and Greg Linteris is Payload Specialist-2. Both Crouch and Linteris are making their second space flight.

Columbia is targeted for launch on July 1 from NASA's Kennedy Space Center (KSC) Launch Complex 39-A at 2:37 p.m. EDT at the opening of a 2 _ hour available launch window. With an on-time launch on July 1 and a nominal 16-day mission, Columbia will land back at KSC on July 17 at about 7:13 a.m. EDT.

The primary focus for mission STS-94 is the same as it was for STS-83 -- to conduct experiments and evaluate facilities associated with the Microgravity Science Laboratory-1 (MSL-1) payload. The MSL flight serves as a bridge to America's future in space with a mission that spans the gap between the relatively short duration work done on today's Shuttle Spacelab flights to the long duration research that will be performed on the International Space Station.

The STS-94 mission will continue the test begun during STS-83, of hardware, facilities and procedures that will be used on the International Space Station. It will carry on the evaluation of procedures designed to place scientific payloads into orbit in a shorter amount of time than previously possible. This MSL flight will again serves as a test-bed for new ways to conduct experiments in space -- helping to validate and improve that process. New methods of integrating experiments and equipment will be introduced, requiring new procedures at every step.

The STS-94 flight mirrors the future work aboard the Space Station in the international complexion of the flight. The MSL mission once again brings together academic, industrial and governmental partners from around the world. Scientists from four space agencies developed 33 investigations for the MSL-1 mission. Representatives of the European Space Agency, the German Space Agency and the National Space Development Agency of Japan are joining NASA and scientists throughout the United States in this research mission.

The STS-94 mission will fly some new experiment facilities, that first flew on STS-83, and are designed to give scientists additional tools for finding answers in the microgravity of space. One such new component on MSL-1 is the innovative EXPRESS Rack, standing for "EXpedite the PRocessing of Experiments to the Space Station." It is designed for quick and easy installation of experiment and facility hardware on orbit and will provide the same structural and resource connections the rack will have on ISS.

Another advanced operational concept again being tested on STS-94 is the use of "expert" software systems. Designed to reduce the number of people now required to support ISS operations, the software packages will help human controllers provide rapid response to changes in mission operations.

The work performed on the MSL flight has direct impact to life back on Earth. The protein crystals being grown on the flight may help scientists better understand the structure of various diseases and possible cures. The experiments designed to examine the combustion process will help improve the design of more efficient, clean-burning combustion engines and also shed light on issues of fire safety. The materials science investigations will help researchers understand how the structure of a material forms and how this structure affects the material's properties with implications from electronic materials, to the strength or resistance to corrosion of some materials, to how flaws in glasses and alloys can make them crack or break more easily.

STS-94 will be the 23rd Flight of Columbia and the 85th mission flown since the start of the Space Shuttle program in April 1981.

MEDIA SERVICES INFORMATION

NASA Television Transmission

NASA Television is available through the GE2 satellite system which is located on Transponder 9C, at 85 degrees west longitude, frequency 3880.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, FL; Marshall Space Flight Center, Huntsville, AL; Dryden Flight Research Center, Edwards, CA; Johnson Space Center, Houston, TX; and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued before launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once each day. The updated NASA television schedule will indicate when mission briefings are planned.

Internet Information

Information on STS-94 is available through several sources on the Internet. The primary source for mission information is the NASA Shuttle Web, part of the World Wide Web. This site contains information on the crew and their mission and will be regularly updated with status reports, photos and video clips throughout the flight. The NASA Shuttle Web's address is:

http://shuttle.nasa.gov

If that address is busy or unavailable, Shuttle information is available through the Office of Space Flight Home Page:

http://www.osf.hq.nasa.gov/

General information on NASA and its programs is available through the NASA Home Page and the NASA Public Affairs Home Page:

http://www.nasa.gov

or http://www.gsfc.nasa.gov/hqpao/hqpao_home.html

Information on other current NASA activities is available through the Today@NASA page:

http://www.hq.nasa.gov/office/pao/NewsRoom/today.html

The NASA TV schedule is available from the NTV Home Page:

http://www.hq.nasa.gov/office/pao/ntv.html

Status reports, TV schedules and other information also are available from the NASA Headquarters FTP (File Transfer Protocol) server, ftp.hq.nasa.gov. Log in as anonymous and go to the directory /pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their E-mail address as the password. Within the /pub/pao directory there will be a "readme.txt" file explaining the directory structure:

* Pre-launch status reports (KSC): **ftp.hq.nasa.gov/pub/pao/statrpt/ksc**
* Mission status reports(JSC): **ftp.hq.nasa.gov/pub/pao/statrpt/jsc**
* Daily TV schedules: **ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked.**

NASA's Spacelink, a resource for educators, also provides mission information via the Internet. The system fully supports the following Internet services:

* World Wide Web: **http://spacelink.msfc.nasa.gov**
* Gopher: **spacelink.msfc.nasa.gov**
* Anonymous FTP: **spacelink.msfc.nasa.gov**
* Telnet : **spacelink.msfc.nasa.gov**

Spacelink's dial-up modem line is 205/895-0028.

Access by CompuServe

Users with CompuServe accounts can access NASA press releases by typing "GO NASA" (no quotes) and making a selection from the categories offered.

STS-94 QUICK LOOK

Launch Date/Site:	July 1, 1997/KSC Launch Pad 39-A
Launch Time:	2:37 P.M. EDT
Launch Window:	2 hours, 30 minutes
Orbiter:	Columbia (OV-102), 23rd flight
Orbit Altitude/Inclination:	160 nautical miles, 28.45 degrees
Mission Duration:	15 days, 16 hours, 36 minutes
Landing Date:	July 17, 1997
Landing Time:	7:13 A.M. EDT
Primary Landing Site:	Kennedy Space Center, Florida
Abort Landing Sites:	Return to Launch Site - KSC Transoceanic Abort Sites - Banjul, The Gambia, Ben Guerir, Morocco, Moron, Spain Abort-Once Around - Edwards AFB, CA
Crew:	Jim Halsell, Commander (CDR), 4th flight Susan Still, Pilot (PLT), 2nd flight Janice Voss, Payload Commander, Mission Specialist 1 (MS 1), 4th flight Mike Gernhardt, Mission Specialist 2 (MS 2), 3rd flight Don Thomas, Mission Specialist 3 (MS 3), 4th flight Roger Crouch, Payload Specialist 1 (PS 1), 2nd flight Greg Linteris, Payload Specialist 2, (PS 2), 2nd flight
Spacelab Teams:	***Red Team***: Halsell, Still, Thomas, Linteris ***Blue Team***: Voss, Gernhardt, Crouch
EVA Crewmembers: (if needed, contingency)	Mike Gernhardt (EV 1), Don Thomas (EV 2)
Cargo Bay Payloads:	MSL-1, CRYOFD, OARE
In-Cabin Payloads:	SAREX, MSX

CREW RESPONSIBILITIES

Payloads	Prime	Backup
MSL-1 Activation/Deactivation	Voss	Gernhardt
MSL-1 Science	Voss	Others
Secondary Experiments	Gernhardt	Halsell, Still
EVA (if needed)	Gernhardt (EV 1)	Thomas (EV 2)
Intravehicular Crewmember	Still	-----
Earth Observations	Still	Gernhardt
SAREX	Halsell	Gernhardt

DEVELOPMENT TEST OBJECTIVES

DTO 255: Wraparound DAP Flight Test Verification
DTO 312: External Tank TPS Performance
DTO 416: Water Spray Boiler Quick Restart Capability
DTO 667: Portable In-Flight Landing Operations Trainer
DTO 677: Evaluation of Microbial Capture Device in Microgravity
DTO 684: Radiation Measurement in Crew Compartment
DTO 805: Crosswind Landing Performance

DETAILED SUPPLEMENTARY OBJECTIVES

DSO 331: Integration of the Space Shuttle Launch and Entry Suit
DSO 487: Immunological Assessment of Crewmembers
DSO 493: Monitoring Latent Virus Reactivation and Shedding in Astronauts

RISK MITIGATION EXPERIMENTS

RME 1330: Wireless Data Acquisition System

PAYLOAD AND VEHICLE WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Columbia) empty and 3 SSME's	187,634
Shuttle System at SRB Ignition	4,522,854
Orbiter Weight at Landing with Cargo	259,705
MSL-1 Spacelab Module	22,418
CRYOFD	763
OARE	252

MISSION SUMMARY TIMELINE

Flight Day One:
Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
Spacelab Activation
MSL-1 Science Operations

Flight Day 2-14:
MSL-1 Science Operations

Flight Day 15:
MSL-1 Science Operations
Crew News Conference

Flight Day 16:
MSL-1 Science Operations
Flight Control System Checkout
Reaction Control System Hot-Fire
Cabin Stow
Spacelab Deactivation

Flight Day 17:
Deorbit Preparation
Payload Bay Door Closing
Deorbit Burn
KSC Landing

SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes for STS-82 include:

* Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with the orbital maneuvering system engines.

* Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit of the Earth before landing at the Kennedy Space Center, FL.

* Transoceanic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Bajul, The Gambia; Ben Guerir, Morocco; or Moron, Spain.

* Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, and without enough energy to reach a TAL site, would result in a pitch around and thrust back toward Kennedy until within gliding distance.

MICROGRAVITY SCIENCE LABORATORY-1 (MSL-1)

The first Microgravity Science Laboratory mission (MSL-1) is the bridge to America's future in space -- the mission spanning the gap between today's Spacelab and tomorrow's International Space Station.

MSL-1 will connect the foundations of American space exploration and discovery, laid by the Apollo, Skylab and Spacelab programs, to the Space Station.

Using Spacelab as a test-bed, MSL-1 will test some of the hardware, facilities and procedures that will be used on the International Space Station.

MSL-1 incorporates new and existing facilities to expand previous research -- and begin exploration in new directions.

With its primary goal as an orbiting laboratory for long-term research in microgravity, MSL-1 will introduce new procedures designed to place scientific payloads into orbit in a shorter amount of time than previously possible. It will serve as a test-bed for new ways to conduct experiments in space -- helping to validate and improve that process. New methods of integrating experiments and equipment will be introduced, requiring new procedures at every step.

Bringing together international academic, industrial and governmental partners in a venture that will model future operations, MSL-1 builds on past cooperative and scientific foundations. Those include the International Microgravity Laboratory missions, the U.S. Microgravity Laboratory missions, Spacelab J and the German Spacelab missions.

By thoroughly testing these new procedures, hardware, and systems, MSL-1 will help ensure that Space Station research has the best start possible. The information and samples from the mission's scientific investigations also will ensure mature, long-term research in microgravity.

MSL-1 Science

Scientists from four space agencies developed 33 investigations for the MSL-1 mission. Representatives of the European Space Agency, the German Space Agency and the National Space Development Agency of Japan are joining NASA and scientists throughout the United States in this mission of discovery.

The crew will conduct these experiments inside Spacelab, a versatile research laboratory which fits in the Space Shuttle cargo bay. With its extra work area, power supplies, information management capability and versatile equipment racks, scientists in space can work much as they would in their laboratories on Earth.

Many MSL-1 experiments owe their heritage to earlier Skylab, sounding rocket and ground-based experiments. Some experiments have evolved over several Spacelab missions. Some flown on previous flights are being flown again to probe new scientific questions or further explore prior studies.

Experiment Facilities

This mission will introduce some new experiment facilities, designed to give scientists additional tools for finding answers in the microgravity of space.

A new, key component on MSL-1 is the innovative EXPRESS Rack, standing for "EXpedite the PRocessing of Experiments to the Space Station." It is designed for quick and easy installation of experiment and facility hardware on orbit.

On MSL-1, the EXPRESS Rack will replace a Spacelab double rack, and special hardware will provide the same structural and resource connections the rack will have on Space Station. Two payloads -- the Physics of Hard Spheres experiment and the Astro/Plant Generic Bioprocessing Apparatus experiment -- will be flown to check the design, development and adaptation of the EXPRESS Rack hardware.

Another advanced operational concept being tested on MSL-1 is the use of "expert" software systems. Designed to reduce the number of people now required to support Space Station operations, the software packages will help human controllers provide rapid response to changes in mission operations. If there is an unscheduled event during a mission, the system will provide immediate information about its impact on the operation of each experiment.

Conducting Science in Microgravity

The microgravity environment of the orbiting Space Shuttle provides unique opportunities to researchers.

Subtle and complex phenomena, normally hidden by the stronger force of gravity, can be revealed for detailed study. Mixtures that separate on Earth because of the different densities of their components can be mixed evenly and processed in microgravity. This allows scientists to study the processing of such materials and possibly to create advanced materials for study and comparison.

The growth of near-perfect protein crystals will enhance our understanding of protein molecular structures and may speed the development of improved drugs.

Also, scientists can use the microgravity environment of space to learn how the presence or absence of gravity affects living organisms. This will aid long-term space efforts and provide a better understanding of life on Earth by allowing scientists to study biological processes and phenomena impossible to study in gravity.

Protein Crystallography

Science has gained a better understanding of various diseases through research known as protein crystallography. Proteins are essential components of all living cells and serve many different functions. By studying a protein that is part of a virus, researchers can learn how that virus attacks plants or animals.

To determine the exact structure of a selected protein, scientists must grow near-perfect crystals of that protein. While some proteins can be crystallized easily on Earth, gravity works against the formation of perfect crystals of any substance. By growing protein crystals in microgravity, investigators can get significantly closer to the ideal of perfection.

Three protein crystal growth experiments are scheduled for MSL-1. The Protein Crystal Growth Using the Protein Crystallization Apparatus for Microgravity experiment will grow large quantities of various proteins. The Protein Crystal Growth Using the Second Generation Vapor Diffusion Apparatus experiment will grow high-quality crystals of various proteins using the alternate method known as vapor diffusion. The Protein Crystal Growth Using the Hand-Held Diffusion Test Cells experiment will grow crystals to investigate differences in the processes in microgravity from those on Earth and to refine the cell design for the Observable Protein Crystal Growth Apparatus.

Combustion Science

Combustion -- the more scientific term for burning -- plays a key role in processes involved in ground transportation, spacecraft and aircraft propulsion, and hazardous waste disposal. Yet, despite years of study, there is only a limited understanding of many fundamental combustion processes because Earth's gravity limits studies -- again, by masking many subtle phenomena.

The microgravity environment of space, however, allows scientists to expand the scale and duration of experiments and to study details hidden on Earth.

The MSL-1 mission will support three combustion investigations. The Laminar Soot Processes experiment will explore the properties and processes of soot and flames. The Structure of Flame Balls at Low Lewis-number experiment will try to determine if stable "flame balls" can exist. The Droplet Combustion Experiment will study the processes and phenomena associated with combustion in spherical fuel droplets.

Results from these experiments will improve understanding of how fundamental combustion phenomena are affected by gravity; advance combustion science and technology on Earth -- including the improved design of more efficient, clean-burning combustion engines; and shed light, as well, on issues of fire safety in space.

Materials Science

The key to materials science research is understanding how the structure of a material forms and how this structure affects the material's properties.

On Earth, sedimentation and buoyancy cause uneven mixing of a material's ingredients and can deform the structure as it solidifies. These gravity-induced imperfections limit the usefulness of many electronic materials. Imperfections in the structures of metals and alloys can affect mechanical strength or resistance to corrosion, while similar flaws in glasses and alloys can make them crack or break more easily. Gravity also affects the internal structure of polymers, long chains of organic molecules that form the basis of a range of products from nylon to plastic.

In microgravity, sedimentation and buoyancy are reduced or eliminated, allowing scientists to study the process of material formation in ways never before possible. Minute forces and phenomena that are overwhelmed by gravity on Earth can be observed and studied. Physical and chemical conditions present during processing can be controlled and changed, enabling investigators to learn how these factors affect the final structure of the material.

MSL-1 will feature 19 materials science investigations in three major facilities. These facilities are the Large Isothermal Furnace, the EXPRESS Rack and the Electromagnetic Containerless Processing Facility.

Additional technology demonstrations and experiments will be performed in the Middeck Glovebox facility.

The knowledge gained from these studies will benefit future microgravity research and material processing efforts and also will be used to improve materials processing on Earth.

Mission Operations

The Marshall Space Flight Center in Huntsville, Ala., manages MSL-1 as NASA's lead center for microgravity research.

Experiment operations for the 16-day flight will be directed from the Spacelab Mission Operations Control center at Marshall.

During the mission, scientists and engineers representing many MSL-1 experiments will work in Marshall's Science Operations Area. There, they will monitor experiments by video and voice links with the Shuttle, send remote commands to their instruments, discuss operations with the MSL-1 crew, and coordinate mission activities with members of other experiment teams.

The teams will be backed by colleagues working at remote sites for science operations and support.

Remote operations have been an important part of previous Spacelab missions. But MSL-1 will refine their operation, while making use of previous hardware and facilities. MSL-1 will have new remote operations in Tsukuba, Japan, as well as sites at Lewis Research Center in Cleveland, Ohio; and the University of Colorado at Denver. Also, a remote site -- distinct from the Spacelab Mission Operations Control facility -- will be operational at Marshall for the Glovebox experiments. Additional science teams will be located at the Johnson Space Center in Houston, Texas, and the Kennedy Space Center in Florida.

Primary responsibility for operating the experiments in orbit belongs to the Spacelab science crew. Payload Commander Janice E. Voss, Mission Specialists Donald A. Thomas and Payload Specialists Roger K. Crouch and Gregory Linteris will work in two 12-hour shifts. Operating Spacelab 24 hours a day enables scientists to obtain the most from valuable time in orbit. The crew will work from a pre-planned master timeline, with adjustments allowed for unexpected opportunities.

After landing, many experiment samples -- some with limited lifetimes -- will be returned to the scientists for evaluation.

Later, experiment hardware will be returned to the space agency that developed it. Computer tapes, voice recordings, video tapes and other information collected in the experiments will be organized and forwarded to investigators. Analysis of the results will start even before the Space Shuttle returns to Earth, and may continue for several years.

The investigators will be rewarded with new insights into the intrinsic properties of materials and increased knowledge of how gravity affects living systems on Earth. MSL-1 will certainly provide new questions for scientists and engineers seeking additional answers in the unique laboratory of space.

COMBUSTION MODULE-1

Combustion Module-1 was developed by NASA to test hardware and experiment techniques on Spacelab. The module can accommodate a variety of combustion experiments through the use of experiment-unique chamber inserts called Experiment Mounting Structures.

It requires two Spacelab racks--one double and one single-- with a combined weight of 1,600 pounds.

Housed in the double rack is the Experiment Package. The package contains a 24 gallon combustion chamber, a gas chromatograph, seven cameras, the experiments' computers, and support equipment.

The combustion chamber has slide rails and can be quickly disconnected, allowing the crew to insert and connect the Experiment Mounting Structures.

The single rack contains the Fluid Supply Package and the Video Cassette Recorder Package. The Fluid Package consists of 20 bottled gases and supplies gas for combustion, combustion chamber purges, soot sampling, chemical diagnostics, on-orbit leak tests, and pure air in the combustion chamber for science and crew access.

Combustion Module-1 will support two investigations during the mission.

Experiment: Laminar Soot Processes
Facility: Combustion Module 1
PI: Dr. Gerard Faeth, University of Michigan in Ann Arbor.

Laminar jet diffusion flames involve the combustion of a hydrocarbon fuel in still air. They are similar to candle flames except that the fuel is supplied by a gas jet rather than by evaporation from a wick. The shape of a laminar jet diffusion flame approximates combustion processes in many practical devices, such as diesel engines, aircraft jet engines and furnaces. Information will be collected on flame shape, the type and amount of soot produced under various conditions and the temperature of soot components. This experiment could lead to ways to contain unwanted fires, and also limit the number of fatalities from carbon monoxide emissions. Scientists also hope to use information learned from the experiment to improve theoretical models of combustion.

Experiment: Structure of Flame Balls at Low Lewis-number (SOFBALL)
Facility: Combustion Module-1
PI: Dr. Paul Ronney, University of Southern California in Los Angeles

The purpose of the investigation is to determine if stable balls of flame can exist. If proven they can, additional studies may determine if radiative loss is the stabilizing mechanism and how mixture properties affect flame balls. Information gained from this experiment could lead to improvements in lean-burn internal combustion engines, to increase efficiency and to reduce emissions. Other benefits may include improved fire safety for mine shafts, chemical plants and spacecraft.

DROPLET COMBUSTION APPARATUS

The Droplet Combustion Apparatus is an enclosed chamber in which one investigation, the Droplet Combustion Experiment, will process during MSL-1.

Experiment: Droplet Combustion Experiment
Facility: Droplet Combustion Apparatus
PI: Dr. Forman Williams, University of California at San Diego

The purpose of the experiment is to collect information on burning rates of flames, flame structures and conditions when extinguishing a flame. Combustion of fuel droplets is an important element in heating furnaces for materials processing, heating homes and businesses, producing power by gas turbines, as well as combustion of gasoline in vehicle engines. With improved understanding of droplet combustion, the results of this experiment could lead to cleaner and safer ways to burn fossil fuels, and more efficient methods of generating heat and power on Earth.

Experiment: Fiber-Supported Droplet Combustion
Facility: Middeck Glove Box
PI: Dr. Forman Williams, University of California at San Diego

The purpose of the experiment is to study how fuels burn and test a new technique of droplet deployment and ignition using thin fibers for positioning. The fiber-supported droplet combustion technique will allow researchers to study fundamental combustion processes, such as how pollutants are formed. The mechanisms that cause the production of soot in flames are among the most important unresolved problems of combustion science because soot affects life on Earth in many ways. Knowledge gained from this experiment could be applied to increased efficiency in the utilization of fossil fuels and to further the understanding of combustion byproducts such as soot and smog.

PROTEIN CRYSTAL GROWTH

Each cell in a living organism contains thousands of different proteins the substances which play essential roles in the maintenance of life. Protein crystals are used in basic biological research, pharmacology and drug development. However, the structures of many important proteins remain a mystery simply because researchers are unable to obtain crystals of sufficient quality or size. Earth's gravity affects the purity and structural integrity of crystals. The low gravity environment in space allows for the growth of larger, purer crystals of greater structural integrity. In some cases, the analysis of protein crystals grown in space has revealed more about a protein's molecular structure than has been possible even after years of effort with crystals grown on Earth. Three protein crystal growth studies will be conducted on MSL-1.

Experiment: Protein Crystallization Apparatus for Microgravity
PI: Dr. Dan Carter of New Century Pharmaceuticals in Huntsville, Ala.

Facility: The Protein Crystallization Apparatus for Microgravity consists of small plastic trays with seven sample wells surrounded by donut-shaped reservoirs. The complete crystallization apparatus comprises nine trays (63 specimens) carried in a cylinder with a crank mechanism.

MSL-1 will carry six cylinders in a Single-locker Thermal Enclosure System and another six in cabin-temperature locker, for a total of 756 specimens.

Experiment: Second-Generation Vapor Diffusion Apparatus
PI: Dr. Larry DeLucas of the Center for Macromolecular Crystallography at the University of Alabama in Birmingham.

Facility: This facility will use vapor diffusion techniques to process eleven different proteins in 80 crystallization chambers. These experiments in protein crystallization research include efforts to obtain detailed structural data on one protein that relates to Chagas' disease, a debilitating and deadly disease that effects more than 20 million people inLatin America and parts of the United States. This work is in collaboration with an Investigators' Working Group currently comprised of

Argentina, Brazil, Chile, Costa Rica, Mexico, Uruguay and the United States as part of a larger effort to help control communicable diseases.

Experiment: Handheld Diffusion Test Cells

PI: Dr. Alexander McPherson of the University of California, Riverside.

Facility: A single unit of the Hand-Held Diffusion Test Cells experiment consists of eight cells mounted on a rail and contained in a protective enclosure. Each test cell has three chambers containing a protein solution, a buffer solution and a precipitant solution chamber. Using the liquid-liquid diffusion method the different fluids are brought into contact but not mixed. Over time, the fluids will diffuse into each other through the random motion of molecules. The gradual increase in concentration of the precipitant within the protein solution causes the proteins to crystallize. A total of 32 specimens will be flown on MSL-1, and results will be used to refine the design of an Observable Protein Crystal Growth Apparatus being designed for later missions

EXPRESS RACK

The EXPRESS Rack is designed to simplify and speed the process of housing, transporting, installing and operating Space Station experiments. Officially called Expedite the Processing of Experiments to the International Space Station, the EXPRESS rack complies with established standards of Space Station hardware.

Developed by NASA's Life Sciences division, the rack contains 10 compartments for housing experiments -- eight smaller compartments called lockers and two larger, standardized compartments called drawers.

During the Microgravity Science Laboratory mission, two experiments will be conducted in the EXPRESS Rack to test and demonstrate the hardware.

The Physics of Hard Spheres Experiment will be transported into orbit in the EXPRESS Rack. It will be housed in four lockers and one drawer of the facility, demonstrating the rack's capability to accommodate smaller, standardized experiments.

The Astro/Plant Generic Bioprocessing Apparatus will be carried into orbit in the Shuttle's middeck and transferred to the EXPRESS Rack once in orbit. The apparatus will be returned to the middeck following the experiment run. This will demonstrate the ease and speed of installing and removing an EXPRESS Rack experiment, a process which will be used to transfer experiments to and from the International Space Station.

Physics of Hard Spheres Experiment
Dr. Paul Chaikin, Princeton University, Princeton, N.J.

Objective: The experiment will examine the changes which occur during the transition of a substances from liquids to solids and solids to liquids. These transitions are fundamental to materials processing. A better understanding of liquid-to-solid and solid-to-liquid transitional phases may result in the improved design of metallic alloys and processing techniques.

The investigation will examine seven, three-component samples of varying concentrations. The samples, contained in glass spheres, will be colloidal systems -- a colloid dispersed in a gas, liquid or solid. A colloidal substance consists of very small particles which will remain suspended in a medium, do not dissolve in it, and will diffract light. Using a Light Scattering Instrument, measurements of diffracted light from the small particles of the colloids will be obtained as varying degrees of force -- produced by a laser in the Light Scattering Instrument -- are applied to the samples.

Astro/Plant Generic Bioprocessing Apparatus (AstroPGBA)
Dr. Louis Stodieck, University of Colorado, Boulder, Colo.

Objective: This experiment will study the effect of space on certain species of plants. Specifically, it will investigate the production of lignin – essential for the formation and joining of woody cell walls in plants; the production of secondary metabolites -- essential to generating energy needed to sustain vital life processes; and changes which occur in the sugars and starches of vegetable plants. From this investigation, researchers hope to determine if these processes are interrelated and how they may be manipulated to improve plant growth and production on Earth. Researchers also hope the study will verify evidence that plants grown in microgravity require less metabolic energy to produce lignin, permitting greater production of secondary metabolites, a source of many medicinal drugs. Secondary metabolites may also serve to attract, repel or poison insects.

Plants to be studied include Artemisia annua, a species of sage native to Southeast Asia and a source of the antimalarial drug artemisinin; Catharanthus roseus, which produces vinca alkaloids, used in chemotherapy treatment of cancer; Pinus taeda (loblolly pine), used widely in the paper and lumber industries; and Spinacia oleracea, a variety of spinach.

LARGE ISOTHERMAL FURNACE

The Large Isothermal Furnace is a facility capable of uniformly heating large samples of metal alloys to 2912 degrees Fahrenheit (1,600 degrees Celsius) and rapidly cooling samples using a flow of helium. A vacuum-heating facility, the furnace consists of a sample container and heating element surrounded by a vacuum chamber.

The furnace will be used to study the diffusion of liquid metals -- the process by which liquid metals mix when heated. This process cannot adequately be studied on Earth because of convection.

The first, convection, is the transfer of heat caused by the movement of fluid particles which results from a variation in concentration and gravity. On Earth, liquids will gradually mix as a result of heat and stirring generated by convection. To study the effect of an outside source of heat and stirring on the mixing process, it is necessary to reduce or eliminate convection.

In the near-zero gravity aboard the orbiting Space Shuttle, researchers are able to study the diffusion process unaffected by convection. The experiments may provide a better understanding of how liquid metals mix, a process vital to the production of high quality metal alloys and products.

Measurement of Diffusion Coefficient by Shear Cell Method

Dr. Shinichi Yoda, National Space Development Agency of Japan (NASDA), Tsukuba, Japan

Objective: This experiment will test the shear cell cartridge, or container, to be used in two investigations conducted in the Large Isothermal Furnace. The cartridge is specifically designed for these two studies which will use the shear cell method to determine the diffusion coefficient -- or an accurate measurement for the fundamental variables which regulate diffusion.

This method involves two column samples of different concentrations. The columns are melted, then rotated into contact with each other for a specific period of time. The resulting single column is sheared into segments and cooled before measurements are taken.

Using the shear cell method, this study may also reveal the rate of diffusion of tin and lead-tin-telluride. Findings may lead to a better understanding of the diffusion process and improved metal alloys and products.

Diffusion of Liquid Metals

Dr. Toshio Itami, Hokkaido University, Sapporo, Japan

Objective: The study is designed to establish an accurate measurement for the fundamental variables which regulate diffusion of liquid tin relative to temperature. On Earth, diffusion experiments conducted at high temperatures have been unsuccessful due to convection, or fluid movement caused by gravity. This experiment may help researchers more clearly define the diffusion process and could lead to improved designs of metallic alloys and processing techniques on Earth.

Diffusion in Liquid Lead-Tin-Telluride

Ms. Misako Uchida, Ishikawajima-Harima Heavy Industries, Tokyo, Japan

Objective: Researchers hope to establish an accurate measurement for the diffusion coefficient of liquid lead-tin-telluride in relative to temperature. On Earth, it is difficult to achieve an equal distribution of particles in this metal mixture as the mixture solidifies. As with other liquid metals, the diffusion process is masked by gravity's influence on the movement of liquid particles. It also appears that diffusion's dependence on temperature is different in microgravity, or near-zero gravity. Lead-tin-telluride holds potential as a material for use in infrared detectors and lasers.

Impurity Diffusion in Ionic Metals

Dr. Tsutomu Yamamura, Tohoku University, Sendai, Japan

Objective: The objective of the study is to determine an accurate measurement for the diffusion coefficient of a tracer, or impurity, in molten salts. Conducting the study in the microgravity environment of the Space Shuttle will eliminate convection, or fluid movement caused by gravity. On Earth, convection disturbs the diffusion process, resulting in inconsistent measurements.

In addition, the study is designed to reveal ideal conditions for electrolysis of molten salts. Electrolysis is the use of an electrical current to break down a dissolved substance into its constituent components.

The experiment may provide needed information to improve the diffusion process. An accurate measurement for the diffusion coefficient in molten salts would also be useful in basic science and engineering work.

Liquid Phase Sintering II
Dr. Randall German, Pennsylvania State University, University Park, Penn.

Objective: The investigation will test theories of liquid-phase sintering -- to heat and liquefy materials to form a mixture without reaching the melting point of the solid phase material. Specifically, the study will examine the coalescence, or mixing together, of materials during liquid-phase sintering. The investigation will also look at changes that occur in the materials' pores which allow the mixing of fluids during liquid-phase sintering. Information gathered will be compared with theoretical predictions in hopes of improving theoretical models and developing a better understanding of sintering in microgravity.

Diffusion Processes in Molten Semiconductors
Dr. David N. Matthiesen, Case Western Reserve University, Cleveland, Ohio

Objective: The experiment is designed to determine an the diffusion coefficient relative to temperature, impurities and diameter of the sample. Specifically, researchers hope to establish an accurate measurement for the fundamental variables which regulate the diffusion of tracers, or impurities, of gallium, silicon and antimony in melted germanium. On Earth, the movement of tracers during the processing of semiconductors or other materials results from a combination of diffusion and gravity-generated convection, or fluid movement caused by gravity. Since diffusion and convection cannot be separated on Earth, scientists have not been able to accurately measure the diffusion coefficient. This research is aimed at developing better models of diffusion.

MEASURING MICROGRAVITY

Space Acceleration Measurement System (SAMS)
Project Scientist: Dr. Peter Tschen, NASA Lewis Research Center, Cleveland, Ohio

Objective: The effects of Earth's gravity on the Space Shuttle and its cargo are markedly reduced when in orbit. But so strong are the forces of gravity, the effects are never completely eliminated. Disturbances occur when crew members move about the Shuttle, when onboard equipment is operated, or thrusters are fired to maneuver the Shuttle to its proper position. Even slight, atmospheric drag on the Shuttle can create disturbances that mimic gravity. Such minute changes in the orbital environment of the Shuttle can effect sensitive experiments being conducted onboard. Researchers and scientists conducting experiments on the Microgravity Science Laboratory mission will depend on the Space Acceleration Measurement System to record precise measurements of such changes. The system will enable them to adjust their experiments and improve the collection of scientific information during the mission. The system's measurements also aid in determining how vibrations or accelerations affect the results of experiments.

System Operation: The system accurately measures and maps the acceleration environment in orbit, using three remote sensor heads mounted in different locations. Each sensor head has three accelerometers oriented to enable the detection of accelerations three-dimensionally, in the range of .01- to 100-Hertz. For this mission, one sensor head will detect accelerations up to 2.5 Hertz, while others can detect accelerations up to 25 Hertz.

Information collected by the sensors is transmitted to the ground through the Shuttle's communications system. This allows scientists to make immediate assessments of the effects of the microgravity environment, and make necessary corrections for their experiments.

Quasi-Steady Acceleration Measurement (QSAM)

Project Scientist: Dr. Hans Hamacher, German Aerospace Research Establishment (DLR)

Objective: Researchers who conduct scientific experiments in the microgravity environment of space require as few disturbances as possible. But even the near-vacuum of space has some forces of gravity and vibration. Among the disturbances encountered on a Space Shuttle mission are rapidly changing movements by the crew or periodic equipment operations. And steady accelerations -- changes in velocity -- such as a slight pull on the Shuttle created by atmospheric drag, also create disturbances making it impossible to achieve complete zero-gravity conditions.

Different experiments conducted in space are sensitive to different types of accelerations. To accurately interpret the results of their experiments, researchers need to know the precise level of accelerations that occur at all times during their experiments.

The Quasi-Steady Acceleration Measurement (QSAM) experiment is primarily designed to detect steady, very low-frequency, residual accelerations between 0 and 0.02 Hertz, or cycles per second.

System Operation: Low-frequency accelerations affect various physical processes more than higher-frequency accelerations. By means of a unique design of its sensor heads, the Quasi-Steady Acceleration Measurement experiment is able to make precise measurements of this important acceleration range.

This system complements three others that are measuring disturbances on the Microgravity Science Laboratory mission. Together, the four systems provide detection of the entire range of accelerations that may affect experiments.

Orbital Acceleration Research Experiment (OARE)
Project Scientist: Dr. Peter Tschen, NASA Lewis Research Center, Cleveland, Ohio

Objective: There is no line -- no hard boundary -- between Earth's atmosphere and space. At the Earth's surface, the atmosphere is thickest, and it gradually thins with increasing elevation. Even altitudes reached by the Space Shuttle are not completely without air. The Shuttle travels very rapidly through this tenuous, near-vacuum atmosphere. But the Shuttle is slightly slowed, or decelerated, by friction with the gas molecules. And because the density of the atmosphere changes from day to night, the amount of friction varies proportionally.

The Orbital Acceleration Research Experiment (OARE) makes extremely accurate measurements of these variations and other disturbances, using a sensor called an accelerometer, and records them for later analysis. Analysis of these and other types of microgravity disturbances enables researchers to assess the influence of Shuttle accelerations on the scientific experiments carried onboard the Microgravity Science Laboratory.

System Operation: The Orbital Acceleration Research Experiment is a self-calibrating instrument that monitors and records extremely small accelerations -- changes in velocity -- and vibrations that are experienced during orbit of the Shuttle. At the heart of the instrument is a miniature electrostatic accelerometer that precisely measures low-frequency, on-orbit acceleration disturbances. The OARE is capable of sensing and recording accelerations on the order of one-billionth the acceleration of Earth's gravity -- 1 nano-g -- at a frequency of less than 1 Hertz, or once per second.

The instrument's principal purpose is to help determine the orientation of the least acceleration disturbance for the Shuttle orbiter during flight. Information is collected and measured by the instrument. Then it is processed, stored and transmitted in near real-time to scientists on Earth. Based on this information, the Shuttle's flight attitude can be adjusted to satisfy the needs of any particular experiment.

Microgravity Measurement Assembly (MMA)
Project Scientist: Dr. Hans Hamacher, German Aerospace Research Establishment (DLR)

Objective: Many experiments onboard the Microgravity Science Laboratory require a very smooth ride through space so that their delicate operations are not disturbed. Yet even in the quiet, low-gravity environment of space, disruptions occur from movements by the crew, equipment operations and occasional firing of thrusters to adjust the orbital position of the Shuttle.

One of the systems developed to measure disruptions to experiments caused by accelerations is the Microgravity Measurement Assembly (MMA).

System Operation: The Microgravity Measurement Assembly determines both high- and low-frequency spacecraft disturbances, collecting measurements from seven sensor heads placed at selected locations in the Spacelab. Four of the sensor heads are placed in the Spacelab experiment racks, where many of the gravity-sensitive investigations are located. Most of the MMA sensors can detect accelerations in the range of 0.1- to 100-Hertz. One sensor, called the Accelerometre Spatial Triaxial Electrostatique, can measure accelerations below 1.0 Hertz.

Information collected from the sensors is sent to the instrument's central computer. It can be transmitted in real-time to researchers on the ground, where they can promptly assess measurements of the microgravity environment vs. the requirements for various experiments. From this, plans can be made for possible corrective actions for particular experiments.

TEMPUS

Electromagnetic Containerless Processing Facility (German: Tiegelfreies Elektromagnetisches Prozessieren Unter Schwerelosigkeit, or TEMPUS.)
Hardware Developer:
Wolfgang Dreier, German Space Agency (DARA)

Project Scientists: Dr. Ivan Egry, German Aerospace Research Establishment (DLR), Cologne, Germany and Dr. Jan Rogers, NASA Marshall Space Flight Center, Huntsville, Ala.

The Electromagnetic Containerless Processing Facility -- referred to by its German acronym TEMPUS -- was developed by the German Space Agency. It is an electromagnetic levitation facility that allows scientists on the ground to process metallic samples in a containerless microgravity environment. TEMPUS uses a combination of an electromagnetic field and the microgravity environment to suspend metal alloys in free space within a set of coils so the alloys may be melted and resolidified in an ultra-pure environment. By levitating the sample within the coils, researchers can study the alloy's solidification while ensuring the sample does not touch any container's walls. The facility records information on the alloys while they are molten as they solidify.

The TEMPUS facility first flew on the second International Microgravity Laboratory (IML-2), a Shuttle and Spacelab mission in July 1994.

Electromagnetic levitation is commonly used in ground-based experiments to melt and then cool metallic substances below their "freezing" points while preventing solidification from occurring. The process of cooling metallic melts below their normal freezing points without solidification is termed "undercooling." The ability of very pure liquid alloys, in a microgravity environment, to remain liquid at hundreds of degrees below their normal solidification points is due to the absence of contact with other materials.

During the MSL-1 mission, scientists will perform experiments which build upon those conducted during IML-2, studying various thermodynamic and kinetic properties of 18 samples. For each investigation, a small spherical sample, about 5/16 inch round (7-8 mm), will be positioned by the electromagnetic coil, melted, and then cooled. Melting points of the samples range between 1,400-3,362 F (760-1,850 C), with the maximum sample temperature about 3,812 F (2,100 C).

A key phenomenon to be studies is nucleation. This is the initial stage of crystalline solidification, when small, isolated clusters of atoms begin arranging themselves into a regular, repeating structure. Atoms fall into place on these clusters, or nuclei, causing the sites to grow until the entire mass becomes solid.

The TEMPUS system provides the means for physically manipulating samples during processing. Rotations and oscillations can be controlled through the application of an electromagnetic field. Nucleation can be initiated at any desired undercooled temperature by inserting a needle into the sample, causing the entire sample to rapidly solidify. Also, the sample can be squeezed by applying short power pulses to the heating or levitation coils. By observing how the sample reacts, properties such as surface tension and viscosity can be determined.

Experiment: Thermophysical Properties of Undercooled Metallic Melts
Facility: Electromagnetic Containerless Processing Facility (TEMPUS)
Principal Investigator: Dr. Ivan Egry, DLR.
Co-Investigators: Dr. Georg Lohoefer, DLR; Dr. Berndt Feuerbacher, DLR.

To measure surface tension, viscosity, and electrical conductivity of liquid and undercooled alloys, specifically palladium-copper-silicon and cobalt-palladium. This experiment will provide information about the heat transfer properties of undercooled metallic melts. Findings from this study will complement existing information on liquid metals at and above the melting point, providing insight into the largely unexplored state where an undercooled liquid begins to solidify.

Experiment: Thermophysical Properties of Advanced Materials in the Undercooled Liquid State
Facility: TEMPUS
Principal Investigator: Dr. Hans F. Fecht, Technical University Berlin, Germany.
Co-Investigator: Dr. Rainer Wunderlich, Technical University Berlin.

This experiment will measure the heating properties of undercooled metallic substances to help researchers further understand how metallic glass forms in zirconium-based alloys. Comparisons between different alloys should indicate how the glass-forming ability of an alloy is related to its composition. Understanding the fundamentals of undercooling and formation of metallic glasses is vital for designing such materials. They may find applications in many technological areas because of their unique mechanical and physical properties. Some present areas of application include high-powered laser choke switches, transformer cores, brazing alloys, wear-resistant coatings and reinforcing fibers in metal matrices. In the future, these injection-molded, bulk metallic glasses could influence the state of materials science and engineering.

Experiment: Measurements of the Surface Tension of Liquid and Undercooled Metallic Melts by Oscillating Drop Technique
Experiment Facility: TEMPUS
Principal Investigator: Dr. Martin G. Frohberg, Technical University Berlin, Germany.
Co-Investigator: Dr. Michael Roesner-Kuhn, Technical University Berlin.

This experiment studies the surface tension of liquid metal drops, which are levitated and positioned in an electromagnetic field. The physical property of surface tension results from the forces of mutual attraction of the molecules making up a liquid. These forces cause the molecules at the drop's outer surface to be pulled inward. The approximately spherical shape of rain drops, for example, is a result of surface tension. The strength of the force working on the rain drop or any other liquid sample depends on the temperature and purity of the liquid. Scientists currently do not have sufficient data about concentration- and temperature-dependent surface tensions of liquid, and especially undercooled liquid, materials. Industrial processes which may benefit from findings include: metal-gas-slag reactions, filtration of melts, hot sintering of metallic powders, reactions between melts and refractories, solidification processes, and material flow in the interface between two different liquids.

Experiment: Study of the Morphological Stability of Growing Dendrites by Comparative Dendrite Velocity Measurements on Pure Ni and a Dilute Ni-C Alloy in the Earth and Space Laboratory
Experiment Facility: TEMPUS
Principal Investigator: Dr. D. M. Herlach, DLR.
Co-Investigator: Dr. M. Barth, DLR; Dr. B. Feuerbacher, DLR.

This experiment deals with the investigation of the dendritic solidification velocity resulting from small levels of melt undercooling. Dendrites -- from the Greek word for "tree" -- are tiny branching structures that form inside molten metal alloys when they solidify during manufacturing. The size, shape and structure of the dendrites have a major effect on the strength, ductility and usefulness of an alloy. Measurements of the speed of dendritic solidification can be used to test and refine modeling of dendritic growth behavior. This type of experiment must be performed in microgravity because crystal growth can be greatly affected by convective fluid flow, or buoyancy-driven motion, in molten metal. The low-acceleration environment in space effectively eliminates convection. Comparing space experiment data to those obtained on Earth will allow researchers to learn more about the effect convection has on dendrite growth. Information gained from this experiment could have significance in many manufacturing processes, such as welding and casting.

Experiment: Undercooled Melts of Alloys with Polytetrahedral Short-Range Order
Experiment Facility: TEMPUS
Principal Investigator: Dr. D.M. Herlach, DLR
Co-Investigator: Dr. Dirk Holland-Moritz, DLR; Dr. Heinrich Bach, University of Bochum, Germany; Dr. Hans Fecht, Technical University Berlin; Dr. Kenneth Kelton, Washington University, St. Louis; Dr. Berndt Feuerbacher, DLR.

The experiment will investigate the recently discovered and fascinating subject of quasicrystals. The quasicrystalline state, discovered in 1994, is a third state of solid matter -- in addition to the normal crystalline and glassy states. Quasicrystals exhibit excellent structural order based on atom arrangements. This feature provides quasicrystalline materials with a high degree of hardness and novel electrical and physical properties. This experiment is expected to provide a better understanding of nucleation and short-range order phenomena occurring in undercooled melts. Also, measurement of the specific heat (defined as the heat needed to raise one gram of substance one degree Celsius) will enable better analysis of undercooling experiments performed in space, as well as those performed on Earth. Sample materials used in this experiment are three quasicrystal-forming alloys of aluminum-copper-iron and aluminum-copper-cobalt.

Experiment: Thermal Expansion of Glass Forming Metallic Alloys in the Undercooled State
Facility: TEMPUS
Principal Investigator: Dr. K. Samwer, Institute for Physics, University of Augsburg, Germany.
Co-Investigator: Dr. B. Damaschke, Institute for Physics, University of Augsburg; Dr. Ivan Egry, DLR.

To investigate the thermal expansion of multicomponent amorphous alloys in the wide temperature range between the melting point and the glass transition point. Amorphous alloys are alloys consisting of many metals whose atoms are not arranged in the form of crystalline structures. Solids can be subdivided into crystalline or non-crystalline forms based on the internal arrangement of their atoms or molecules. The glass transition point is where this experiment is expected to reveal new information about both a thermodynamic approach to glassy and undercooled metals and the existence of structural changes in the undercooled alloys, which is important for the development of new customized materials.

Experiment: Experiments on Nucleation in Different Flow Regimes
Facility: TEMPUS
Principal Investigator: Dr. Robert Bayuzick, Vanderbilt University, Nashville, Tenn.
Co-Investigators: Dr. William H. Hofmeister, Vanderbilt University; Dr. Michael B. Robinson, NASA Marshall Space Flight Center.

This investigation looks to better understand specific details on how metals solidify and to investigate ways in which the solidification process can be controlled. Scientists hope to pinpoint what phenomenon kicks off solidification. The current understanding of the nucleation of solids is limited to models derived from the classical theory of nucleation. However, the unique environment of Spacelab provides the combination of requirements -- free-floating melts, great control of conditions within the melt and very careful measurement of temperature -- that will allow for an unparalleled opportunity to test the theory. Solidifying metals is one of the most important processes in industry. Learning more about nucleation may provide clues for making different materials. The studies may help determine the nucleation behavior of zirconium, a strong, ductile refractory metal used chiefly in nuclear reactors and chemical processing equipment.

Alloy Undercooling Experiments
Experiment Facility: TEMPUS
Principal Investigator: Dr. Merton Flemings, Massachusetts Institute of Technology (MIT), Cambridge, Mass.
Co-Investigator: Dr. Douglas Matson, MIT; Dr. Wolfgang Löser, Institut für Festkoerper und Westoffordchug, Dresden, Germany.

To measure the solidification velocity in steel alloys, using a combination of video and sophisticated temperature measurement techniques. Atoms in molten liquid alloy line up in a specified order as the alloy cools and becomes a solid crystal. Scientists hope to learn more about the order in which atoms attach to each other as they grow into a crystal structure. Investigators also want to study the speed at which the crystallization process occurs. The stainless steels employed in this experiment are the same sort of alloys we are familiar with in everyday life, such as the stainless steel used in pots and pans. However, a unique mode of solidification is being studied in this experiment -- one which will alter the internal structure and properties of the material. This experiment is designed to yield information on the transition phases and the speed at which solidification spreads as the temperature at the start of solidification is changed. The experiment has direct application to the design of steel strip casting facilities on Earth and will help scientists understand how welding processes may be conducted in space. This may help industry make better metals. For example, in the casting of high-performance metal components like jet engine turbine blades, each blade is the result of a crystal grown from a single nucleation site. Improving this process may make it possible to construct turbine blades that would have a greater operating efficiency through being capable to withstand higher temperatures. In another example, in welding stainless steels (where rapid solidification is encountered), unexpected and unexplained structures sometimes occur. The fundamental understanding gained in these experiments should help researchers to understand this behavior and to improve the welding process.

Measurement of Surface Tension and Viscosity of Undercooled Liquid Metals
Experiment Facility: TEMPUS
Principal Investigators: Dr. Julian Szekely (deceased); Dr. Merton Flemings, MIT; Dr. Gerardo Trapaga, MIT.
Co-Investigator: Dr. Robert Hyers, MIT.

This experiment is designed to demonstrate a containerless technique to measure both the viscosity -- or the resistance a gas or liquid has to flowing over a solid surface of other layers of fluid -- and the surface tension of reactive and undercooled liquid metals. The metals include zirconium, gold and metallic glass-forming alloys. The experiment will allow for viscosity measurements that are impossible to achieve in Earth-based experiments because of gravity. In the microgravity environment of space, force and fluid flow velocity is greatly reduced, allowing measurements to be taken. To measure the viscosity of a liquid, the internal flow velocity must be kept below a certain value to prevent a transition to turbulence. In ground-based electromagnetic levitation, the same forces that levitate the sample against gravity cause intensely turbulent internal fluid flows, making the measurement of viscosity impossible. In microgravity, however, the force and fluid flow velocity is greatly reduced. With care, it is possible to reduce the internal fluid flows.

Experiment: AC Calorimetry and Thermophysical Properties of Bulk Glass-Forming Metallic Liquids
Experiment Facility: TEMPUS
Principal Investigator: Dr. W.L. Johnson, California Institute of Technology (Caltech), Pasadena, Calif.
Co-Investigator: Dr. David Lee, Caltech.

The experiment will measure the thermophysical properties of glass-forming metallic alloys. Those properties include specific heat capacity, thermal conductivity, nucleation rates, surface tension, viscosity and thermal expansion. The experiment uses a new experimental method termed "non-contact modulation calorimetry" to measure the heat capacity and thermal conductivity of liquid metallic alloys cooled below the point at which they would normally solidify. The undercooled liquid range is accessible because molten metal alloys remain at liquid temperatures below their freezing point when they are suspended in a containerless manner such as provided by TEMPUS. Results of this investigation may lead to improving methods of processing metallic glasses. An understanding of the undercooling and formation of metallic glasses is vital to the design and processing of such materials. Some present applications for metallic glasses include high-powered laser choke switches, transformer cores, brazing alloys, hard-facing for coal-crusher teeth and oil field drill bits, and fly-ash resistant coatings in boilers. In the future, bulk metallic glasses will be made into increasingly complex shapes and their properties further tailored to applications as wide-ranging as the computer industry, processing plants and recreational sports.

MIDDECK GLOVEBOX

The Middeck Glovebox offers scientists the capability to conduct experiments, test science procedures, and develop new technologies in microgravity. The facility enables crew members to handle, transfer, and manipulate experiment hardware and materials that are not approved for use in the open Spacelab. In addition, the facility is equipped with photographic equipment and video and data recording capability, allowing a complete record of experiment operations.

Coarsening in Solid-Liquid Mixtures

D. Peter Voorhees, North Western University, Chicago, IL

The experiment will examine the process of coarsening in metals and use results developed during the mission to compare with current theoretical models. Coarsening may occur during the high-temperature operation of mechanical devices and may result in degradation of the strength of the materials. During coarsening, small particles shrink by loosing atoms to larger particles, causing the larger particles to grow and resulting in lack of uniform particle distribution . Materials containing larger particles are weaker than materials containing many small ones. Although the driving force for coarsening is well characterized, the speed and mechanisms by which it occurs are not.

To develop materials with particular lifetimes and predictable characteristics it is necessary to understand the mechanisms and rates of the coarsening process. This experiment may help researchers develop improved manufacturing processes and stronger metal alloys.

Experiment: Bubble and Drop Nonlinear Dynamics

Dr. L.G. Leal, University of California at Santa Barbara, California

Researchers hope to improve the understanding of how the shape and behavior of bubbles change in response to ultrasonic radiation pressure. It may be possible to develop techniques that eliminate or counteract the complications of that bubbles cause during materials processing. Many industrial applications, including the solidification of certain alloys, involve processes where large numbers of bubbles and drops are used. Scientists will assess their ability to control bubble location, manipulate double bubbles and maximize bubble shape. Shape deformation will be studied using ultrasonic pressure.

Experiment: A Study of Fundamental Operation of a Capillary-driven Heat Transfer (CHT) Device in Microgravity
Dr. Kevin P. Hallinan, University of Dayton, Ohio

Researchers hope to gain an improved understanding of the mechanisms leading to the unstable operation and failure of specialized heat transfer devices in space operations. Capillary-pumped loop devices transfer heat from one location to another, specifically those that move heat away from a particular location, such as in spacecraft where they transfer heat from electrical devices to radiators. The transfer of heat is accomplished by evaporating from one liquid surface at the hot side and condensing the vapor produced at the other side of the loop where heat is discharged into the surrounding area. This experiment investigates the fundamental fluid physics phenomena thought to be responsible for the failure of capillary-pumped loop devices in low-gravity operations.

Experiment: Internal Flows in a Free Drop
Dr. S.S. Sadhal, University of Southern California in Los Angeles, California

Researchers will investigate the capability of current non-contact and remote manipulation techniques for controlling the position and motion of liquids in low-gravity. Free single liquid drops will be deployed and positioned actively using ultrasonic pressure. Tracer particles will within the drops will be recorded by video cameras. Acoustic positioning is an important technique used in containerless processing of materials and in non-contact measurements of viscosity and surface tension. This experiment is important to many processes in chemical manufacturing industries, including such industries as petroleum technology, cosmetics and food sciences.

CRYOGENIC FLEXIBLE DIODE (CRYOFD)

The Cryogenic Flexible Diode (CRYOFD) heat pipe experiment is a Hitchhiker payload flying on Space Shuttle Columbia during the STS-94 mission. Flight testing of heat pipes in space is being conducted to gain advances in passive thermal control technology. Engineers hope to transfer any technology achieved in space to commercial applications on Earth.

Spacecraft electronics are packed tightly together and generate heat, which can limit their performance. Heat pipes can remove heat from the electronics and redirect it to other areas that need heating or to radiators that vent that heat outside the spacecraft. Heat pipes are primarily used in spacecraft and play an ever-increasing role in spacecraft telecommunications.

CRYOFD is a flight experiment jointly developed and sponsored by NASA's Goddard Space Flight Center in Greenbelt, Md. and the U.S. Air Force Phillips Laboratory in Albuquerque. The CRYOFD experiment is on the cutting edge of thermal control technology. The payload consists of two heat pipe experiments: the Cryogenic Flexible Diode Heat Pipe (CFDHP) and the American Loop Heat Pipe with Ammonia (ALPHA). Cryogenic heat pipes are used to cool instruments and improve their performance.

There are two CFDHP units: one uses oxygen as the working fluid to operate at temperatures as low as 60 Kelvin; the other uses methane to operate at temperatures as low as 100 Kelvin. These heat pipes incorporate unique flexible wick designs and flexible bellows to permit easier integration into a spacecraft or with an instrument. Since they are flexible, heat pipes also permit pointing of the instrument.

The ALPHA experiment represents the first flight demonstration of the American Loop Heat Pipe. ALPHA will operate near room temperature (20 °C) and can transport heat loads of up to 500 watts over distances of 1 - 2 meters with a very small temperature drop (e.g., less than 10 °C). Deployable radiators for high power telecommunications spacecraft are a potential application of this technology.

The Hitchhiker Project is managed by the Shuttle Small Payloads Project in the Engineering Directorate at Goddard. Hitchhiker's modular hardware also allows for flexibility in locating and manifesting experiments of different sizes and needs to optimize use of the Shuttle Cargo Bay. Hitchhiker avionics provide power and control data flow between the CRYOFD payload and the Shuttle. The avionics unit also carries the equipment for transmitting the data real-time to Goddard. Experimenters can command their payload and downlink data in realtime from the Payload Operations Control Center located at Goddard.

More information on the CRYOFD mission can be found on the world wide web at: http://sspp.gsfc.nasa.gov/cryofd.htm. The mission manager for the flight of CRYOFD is Susan Olden of Goddard Center and the principal investigator is Marko Stoyanof from USAF Phillips Laboratory in Albuquerque.

SHUTTLE AMATEUR RADIO EXPERIMENT

STS-94 will include Amateur (or "ham") radio, where radio operators and students will attempt to make radio contacts with the orbiting Shuttle as part of a project called Shuttle Amateur Radio EXperiment, or SAREX. Amateur Radio has been flying aboard the Shuttles since 1983.

Ham radio operators from around the world will point their antennas at the Space Shuttle Columbia, hoping to find the astronauts on-the-air. Some of these amateurs have volunteered to assist student groups who have prepared questions to ask the astronauts during specially scheduled contact times. To make their radio contacts, the astronauts will use a radio aboard the Shuttle on frequencies used by ham radio operators.

To operate Amateur Radio from the Space Shuttle, one or more of the astronauts must have an Amateur Radio license. The STS-94 crew members who are licensed Amateur Radio operators include Commander James D. Halsell, Payload Commander Janice E. Voss, and Mission Specialist Donald A. Thomas.

During SAREX missions, the astronauts will typically make the following types of Amateur Radio contacts:

* Scheduled radio contacts with schools.
* Random radio contacts with the Amateur Radio community.
* Personal contacts with the astronauts' families.

SAREX SPONSORS: The Shuttle Amateur Radio EXperiment (SAREX) is sponsored by the American Radio Relay League (ARRL), The Radio Amateur Satellite Corporation (AMSAT) and The National Aeronautics and Space Administration (NASA). SAREX is supported by the Federal Communications Commission.

SHUTTLE TRACKING: Current Keplerian elements to track the Shuttle are available from the following sources:

* NASA Spacelink computer information system
  BBS: (205) 895-0028 [VT-100, 8-N-1]
  Telnet, FTP, and Gopher: spacelink.msfc.nasa.gov
  World Wide Web: http://spacelink.msfc.nasa.gov
  Internet TCP/IP address: 192.149.89.61

* NASA SAREX WWW Home Page:
http://www.nasa.gov/sarex/sarex_mainpage.html
* ARRL
  W1AW news bulletins (frequencies and times listed under "FOR FURTHER INFORMATION")
  BBS: (860) 594-0306
  ARRL World Wide Web: http://www.arrl.org/sarex/
* AMSAT
  World Wide Web: http://www.amsat.org
* Johnson Space Center Amateur Radio Club
  World Wide Web: http://www.phoenix.net/~mbordel/jscarc/index.html
  BBS: (713) 244-5625
* Goddard Amateur Radio Club
  BBS: (301) 286-4137
  World Wide Web: http://garc.gsfc.nasa.gov/www/garc-home-page.html
  Packet: WA3NAN on 145.090 MHz in DC area

CONFIGURATION: During STS-94, the SAREX hardware will be flown in configuration C.

FOR FURTHER INFORMATION:
Contact the American Radio Relay League
Educational Activities Department
225 Main Street, Newington CT 06111-1494 USA
Telephone (860) 594-0301, FAX (860) 594-0259, ARRL BBS (860) 594-0306
Internet sarex@arrl.org
World Wide Web http://www.arrl.org/
CompuServe 70007,3373
America Online HQARRL1

ARRL's (Newington, CT) Amateur Radio station (call sign W1AW) transmits news bulletins (9:45 PM, 12:45 AM EST) on HF bands at 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59 megahertz (MHz).

Members of the Goddard Amateur Radio Club (Greenbelt, MD) re-transmit live, Shuttle air-to-ground audio over the amateur frequencies from their club station, WA3NAN. To listen-in, tune to Amateur Radio high frequency (HF) bands at 3.86, 7.185, 14.295, 21.395, and 28.65 megahertz (MHz) and in the Maryland/DC area, on a very high frequency (VHF) band at 147.45 MHz.

STS-94 CREW BIOGRAPHIES

James Donald Halsell, Jr: STS-94 Mission Commander
(Lieutenant Colonel, USAF)

PERSONAL DATA:

Born September 29, 1956, in West Monroe, Louisiana. He enjoys snow skiing, water skiing, light aircraft flying, running and exercising.

EDUCATION:

Graduated from West Monroe High School, West Monroe, Louisiana, in 1974; received a bachelor of science degree in engineering from the United States Air Force (USAF) Academy in 1978, a master of science degree in management from Troy University in 1983, and a master of science degree in space operations from the Air Force Institute of Technology in 1985.

RECREATIONAL INTERESTS:

Enjoys snow skiing, water skiing, light aircraft flying, running and exercising.

ORGANIZATIONS:

Member of the Society of Experimental Test Pilots (SETP).

SPECIAL HONORS:

Graduated first in test pilot school class and awarded the Liethen/Tittle Trophy for the Best Overall Record for Flying and Academic Performance (1986). Recipient of the Defense Meritorious Service Medal (1995), the Defense Superior Service Medal (1996), and the NASA Space Flight Medal (1995).

EXPERIENCE:

Halsell graduated from the USAF Academy in 1978, and from Undergraduate Pilot Training at Columbus Air Force Base, Mississippi, in 1979. An F-4 pilot, qualified in conventional nuclear weapons deliveries, he served at Nellis Air Force Base, Las Vegas, Nevada, from 1980-1981, and Moody Air Force Base, Valdosta, Georgia, from 1982-1984. In 1984-1985, he was a graduate student at the Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. His thesis prototyped a space rescue transfer vehicle using off-the-shelf equipment. He then attended the Air Force Test Pilot School at Edwards Air Force Base, California, and during the next four years he performed test flights in the F-4, the F-16, and the SR-71 aircraft.

Selected by NASA in January 1990, Halsell became an astronaut in July 1991. Assigned to the Astronaut Office Mission Support Branch, he initially served as a spacecraft communicator (CAPCOM) in the Mission Control Center. Subsequently, he was assigned to the Astronaut Support Personnel team which helps to prepare the Space Shuttle vehicles for flights at the

Kennedy Space Center, Florida. A three flight veteran, Halsell has logged over 645 hours in space. He was the pilot on STS-65 (July 8-23, 1994) and STS-74 (November 12-20, 1995), and was mission commander on STS-83 (Apr 4-8, 1997).

On STS-65, the seven-member crew aboard Space Shuttle Columbia launched from Kennedy Space Center in Florida on July 8, 1994, and returned there on July 23, 1994, setting a new flight duration record for the Space Shuttle program. The STS-65 mission flew the second International Microgravity Laboratory (IML-2). During the 15-day flight the crew conducted more than 80 experiments focusing on materials and life sciences research in microgravity. The mission was accomplished in 236 orbits of the Earth, traveling 6.1 million miles in 353 hours and 55 minutes.

STS-74 was NASA's second Space Shuttle mission to rendezvous and dock with the Russian Space Station Mir. During the 8-day flight the Atlantis crew successfully attached a permanent docking module to Mir and transferred over 2,000 pounds of food, water and scientific supplies for use by the cosmonauts. The STS-74 mission was accomplished in 129 orbits of the Earth, traveling 3.4 million miles in 196 hours, 30 minutes, 44 seconds.

STS-83, the Microgravity Science Laboratory (MSL-1) Spacelab mission, was cut short because of problems with one of the Shuttle's three fuel cell power generation units. Mission duration was 95 hours and 12 minutes, traveling 1.5 million miles in 63 orbits of the Earth.

CURRENT ASSIGNMENT:

Halsell will command the crew of STS-94 a 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission aboard Columbia. The mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997.

Susan Leigh Still: STS-94 Pilot
(Lieutenant Commander, USN)

PERSONAL DATA:

Born October, 24, 1961, in Augusta, Georgia. She enjoys triathlons, martial arts, and playing the piano. Her parents, Joe and Sue Still, reside in Martinez, Georgia. Her mother, Jean Ann Batho Still, is deceased.

EDUCATION:

Graduated from Walnut Hill High School, Natick, Massachusetts, in 1979. Bachelor of science degree in aeronautical engineering from Embry-Riddle University, 1982. Master of science degree in aerospace engineering from Georgia Institute of Technology, 1985.

ORGANIZATIONS:

Association of Naval Aviation.

SPECIAL HONORS:

Distinguished Naval Graduate of Aviation Officer Candidate School; Distinguished Graduate of the United States Naval Test Pilot School, Class 103; Awarded the Navy Commendation Medal, Navy Achievement Medal, and National Defense Service Medal. Ten Outstanding Young Americans Award by the United States Junior Chamber of Commerce.

EXPERIENCE:

After graduating from undergraduate school, Susan worked as a Wind Tunnel Project Officer for Lockheed Corporation in Marietta, Georgia and earned her graduate degree. She was commissioned in 1985 and designated a naval aviator in 1987. Still was selected to be a flight instructor in the TA-4J Skyhawk. She later flew EA-6A Electric Intruders for Tactical Electronic Warfare Squadron 33 in Key West, Florida. After completing Test Pilot School, she reported to Fighter Squadron 101 in Virginia Beach, Virginia for F-14 Tomcat training. She has logged over 2,000 flight hours in more than 30 different aircraft.

NASA EXPERIENCE:

Susan reported to the Johnson Space Center in March 1995. Following a year of training, she worked technical issues for the Vehicle Systems and Operations Branch of the Astronaut Office. More recently, she flew as pilot on STS-83 (April 4-8, 1997). The STS-83 mission was cut short because of problems with one of the Shuttle's three fuel cell power generation units. Mission duration was 95 hours and 12 minutes, traveling 1.5 million miles in 63 orbits of the Earth.

CURRENT ASSIGNMENT:

Susan Still will serve as pilot on STS-94. The 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997 aboard Space Shuttle Columbia.

Janice Voss: STS-94 Payload Commander / Mission Specialist-1
(Ph.D.)

PERSONAL DATA:

Born October 8, 1956, in South Bend, Indiana, but considers Rockford, Illinois, to be her hometown. She enjoys reading science fiction, dancing, volleyball, flying. Her parents, Dr. & Mrs. James R. Voss, reside in Dupont, Indiana.

EDUCATION:

Graduated from Minnechaug Regional High School, Wilbraham, Massachusetts, in 1972; received a bachelor of science degree in engineering science from Purdue University in 1975, a master of science degree in electrical engineering and a doctorate in aeronautics/astronautics from the Massachusetts Institute of Technology in 1977 and 1987, respectively. From 1973 to 1975 she took correspondence courses at the University of Oklahoma. She also did some graduate work in space physics at Rice University in 1977
and 1978.

ORGANIZATIONS:

Member of the American Institute of Aeronautics and Astronautics (AIAA).

SPECIAL HONORS:

NASA Space Flight Medals (1993, 1995); Zonta Amelia Earhart Fellowship (1982); Howard Hughes Fellowship (1981); National Science Foundation Fellowship (1976).

EXPERIENCE:

Dr. Voss was a co-op at the NASA Johnson Space Center from 1973 to 1975. During that time she did computer simulations in the Engineering and Development Directorate. In 1977 she returned to the Johnson Space Center and, for a year, worked as a crew trainer, teaching entry guidance and navigation. She completed her doctorate in 1987 and accepted a job with Orbital Sciences Corporation. Her responsibilities there included mission integration and flight operations support for an upper stage called the Transfer Orbit Stage (TOS). TOS launched the Advanced Communications Technology Satellite (ACTS) from the Space Shuttle in September 1993, and the Mars Observer from a Titan in the Fall of 1992.

Selected by NASA in January 1990, Dr. Voss became an astronaut in July 1991. She is qualified for assignment as a mission specialist on future Space Shuttle flight crews. Her technical assignments have included working Spacelab/Spacehab issues for the Astronaut Office Mission Development Branch, and robotics issues for the EVA/Robotics Branch. Dr. Voss first flew on STS-57 (June 21 to July 1, 1993). Mission highlights included retrieval of the European Retrievable Carrier (EURECA) with the Shuttle's robotic arm, a spacewalk by two crew members, and an assortment of experiments in the first flight of the Spacehab middeck augmentation module. She next flew on STS-63 (February 3-11, 1995). Mission highlights included the rendezvous with the Russian Space Station, Mir, the deployment and retrieval of

Spartan 204, and the third flight of Spacehab. More recently, she flew on STS-83 (Apr 4-8, 1997). The STS-83 Microgravity Science Laboratory (MSL-1) Spacelab mission was cut short because of problems with one of the Shuttle's three fuel cell power generation units. In completing three space flights, Dr. Voss has logged over 533 hours in space.

CURRENT ASSIGNMENT:

Dr. Voss will serve as the payload commander on STS-94. The 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997 aboard Space Shuttle Columbia.

Michael L. Gernhardt: STS-94 Mission Specialist-2
(Ph.D.)

PERSONAL DATA:
Born May 4, 1956, in Mansfield, Ohio. Single. He enjoys running, swimming, triathlons, flying, fishing, snow skiing, tennis, and scuba diving. His father, George M. Gernhardt, resides in Marco Island, Florida. His mother, Suzanne C. Winters, resides in Whitestone, Virginia.

EDUCATION:
Graduated from Malabar High School, Mansfield, Ohio, in 1974; received a bachelor of science degree in physics from Vanderbilt University in 1978; master of science degree and a doctorate in bioengineering from University of Pennsylvania, in 1983 and 1991, respectively.

ORGANIZATIONS:
Member, American Institute of Aeronautics and Astronautics (AIAA), and the Undersea and Hyperbaric Medical Society.

EXPERIENCE:
From 1977 to 1984, Gernhardt worked as a professional deep sea diver and project engineer on a variety of subsea oil field construction and repair projects around the world.
He has logged over 700 deep sea dives and has experience in air, mixed gas, bounce bell and saturation diving. During his diving career Gernhardt attended graduate school at the University of Pennsylvania and developed a new theoretical decompression model based on tissue gas bubble dynamics. He then participated in the development and field implementation of a variety of new decompression tables. From 1984 to 1988, Gernhardt worked as Manager and then Vice President of Special Projects for Oceaneering International. During this time he led the development of a telerobotic system for subsea platform cleaning and inspection as well as a variety of new diver and robot tools. In 1988 he founded Oceaneering Space Systems, a wholly owned subsidiary of Oceaneering International. From 1988 until his selection by NASA in 1992, he worked on the development of new astronaut and robot-compatible tools for performing maintenance on Space Station Freedom. He also worked on the development of new portable life support systems and decompression procedures for extravehicular activity.

NASA EXPERIENCE:
Dr. Gernhardt was selected by NASA in March 1992, and reported to the Johnson Space Center in August 1992. His technical assignments include having served in the Astronaut Office Mission Support Branch, detailed to flight software verification in the Shuttle Avionics Integration Laboratory (SAIL). He also worked on the development of nitrox diving to support training for the Hubble Space Telescope repair and on a variety of Space Station EVA developments. Twice flown, Dr. Gernhardt has logged over 355 hours in space, including 6 hours and 46 minutes of EVA. He was a mission specialist on STS-69 (September 7-18, 1995) and STS-83 (April 4-8, 1997).

The primary objective of STS-69 was the successful deployment and retrieval of a SPARTAN satellite and the Wake Shield Facility (WSF). The WSF is designed to evaluate the effectiveness of using this free-flying experiment to grow semiconductors, high temperature superconductors and other materials using the ultra-high vacuum created behind the spacecraft near the experiment package. Dr. Gernhardt was one of two astronauts to perform a space walk to evaluate future Space Station tools and hardware, logging 6 hours and 46 minutes of EVA. Mission duration was 260 hours, 29 minutes, and 8 seconds, traveling 4.5 million miles in 171 orbits of the Earth.

STS-83, the Microgravity Science Laboratory (MSL-1) Spacelab mission, was cut short because of problems with one of the Shuttle's three fuel cell power generation units. Mission duration was 95 hours and 12 minutes, traveling 1.5 million miles in 63 orbits of the Earth.

CURRENT ASSIGNMENT:

Dr. Gernhardt will serve as a mission specialist on STS-94. The 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997 aboard Space Shuttle Columbia.

Donald A. Thomas: STS-94 Mission Specialist-3
(Ph.D.)

PERSONAL DATA:

Born May 6, 1955, in Cleveland, Ohio. Married to the former Simone Lehmann of Göppingen, Germany. They have one son. He enjoys swimming, biking, camping, flying. His mother, Mrs. Irene M. Thomas, resides in Bloomington, Indiana. Her parents, Margrit and Gerhard Lehmann, reside in Göppingen, Germany.

EDUCATION:

Graduated from Cleveland Heights High School, Cleveland Heights, Ohio, in 1973; received a bachelor of science degree in Physics from Case Western Reserve University in 1977, and a master of science degree and a doctorate in Materials Science from Cornell University in 1980 and 1982, respectively. His dissertation involved evaluating the effect of crystalline defects and sample purity on the superconducting properties of niobium.

ORGANIZATIONS:

Member, American Institute of Aeronautics and Astronautics (AIAA), Tau Beta Pi, and Association of Space Explorers (ASE).

SPECIAL HONORS:

Graduated with Honors from Case Western Reserve University in 1977. Recipient of NASA Sustained Superior Performance Award, 1989. Recipient of NASA Group Achievement Awards in 1990, 1992, and 1994 for his work on the Microgravity Disturbances Experiment, the Shuttle System Safety Review Panel, and development of the Microgravity Measurement Device.

EXPERIENCE:

Following graduation from Cornell University in 1982, Dr. Thomas joined AT&T Bell Laboratories in Princeton, New Jersey, working as a Senior Member of the Technical Staff. His responsibilities there included the development of advanced materials and processes for high density interconnections of semiconductor devices. He was also an adjunct professor in the Physics Department at Trenton State College in New Jersey. He holds two patents and has authored several technical papers. He left AT&T in 1987 to work for Lockheed Engineering and Sciences Company in Houston, Texas, where his responsibilities involved reviewing materials used in Space Shuttle payloads. In 1988 he joined NASA's Lyndon B. Johnson Space Center as a Materials Engineer. His work involved lifetime projections of advanced composite materials for use on Space Station Freedom. He was also a Principal Investigator for the Microgravity Disturbances Experiment, a middeck crystal growth experiment which flew on STS-32 in January 1990. This experiment investigated the effects of Orbiter and crew-induced disturbances on the growth of crystals in space.

He is a private pilot with over 250 hours in single engine land aircraft and gliders, and over 600 hours flying as mission specialist in NASA T-38 jet aircraft.

Selected by NASA in January 1990, Dr. Thomas became an astronaut in July 1991. He has worked in the Safety and Operations Development Branches of the Astronaut Office working on issues relating to Shuttle Orbiter systems, and was also a spacecraft communicator (CAPCOM) for Shuttle missions STS-47, 52 and 53. A veteran of three space flights, he has logged 663 hours and 27 minutes in space. He was a mission specialist on STS-65 (July 8-23, 1994), STS-70 (July 13-22, 1995) and STS-83 (April 4-8, 1997). He is scheduled to fly aboard Columbia on STS-94 in the Summer of 1997.

STS-65 flew the second International Microgravity Laboratory (IML-2) Spacelab module. The seven-member crew aboard Space Shuttle Columbia launched from Kennedy Space Center in Florida on July 8, 1994, and returned there on July 23, 1994 setting a new flight duration record for the Space Shuttle program. During the 15-day flight the crew conducted more than 80 experiments focusing on materials and life sciences research in microgravity. The mission was accomplished in 236 orbits of the Earth, traveling 6.1 million miles.

On STS-70, Dr. Thomas was responsible for the deployment of the sixth and final Tracking and Data Relay Satellite from the Space Shuttle. The five-member crew aboard Space Shuttle Discovery launched from the Kennedy Space Center July 13, 1995, and returned there July 22, 1995. During the 8 day 22 hour mission, the crew completed 142 orbits of the Earth, traveling 3.7 million miles.

STS-83, the Microgravity Science Laboratory (MSL-1) Spacelab mission, was cut short because of problems with one of the Shuttle's three fuel cell power generation units. Mission duration was 95 hours and 12 minutes, traveling 1.5 million miles in 63 orbits of the Earth.

CURRENT ASSIGNMENT:

Dr. Thomas will serve as a mission specialist on STS-94. The 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997 aboard Space Shuttle Columbia.

Roger K. Crouch: STS-94 Payload Specialist-1

PERSONAL DATA:

Considers Jamestown, Tennessee, where he was born September 12, 1940, as his hometown. Currently resides in Laurel, Maryland. One daughter, two sons. Hobbies include traveling, photography, basketball, softball, camping, hiking, fishing, and whitewater rafting. His mother, Mrs. Maxine S. Crouch, lives in Jamestown, Tennessee. His father, Willard Crouch is deceased.

EDUCATION:

Earned a bachelor of science in physics from Tennessee Polytechnic Institute in 1962, a master of science and a doctor of philosophy in physics from Virginia Polytechnic Institute in 1968 and 1971, respectively. He was a visiting scientist at Massachusetts Institute of Technology in 1979-80.

EXPERIENCE:

As the Chief Scientist of the NASA Microgravity Space and Applications Division since 1985 he has served as the manager for a research program that supports materials science, fluid physics, low temperature microgravity physics, combustion science, and biotechnology. He had responsibility for assuring that experiments in the flight program achieved the highest levels of scientific results possible. He served as Program Scientist on Spacelab J, the second International Microgravity Laboratory Program (IML-2), the first United States Microgravity Laboratory (USML-1) and a Program Scientist (Materials Sciences) IML-1. In addition, he helped organize and has served as co-chairman for Microgravity Science Working Groups between NASA and the European Space Agency, France, Germany, Japan and Russia. He was the co-chair of the International Microgravity Science Strategic Planning Group. He was the co-chair for the IML Science Working Group from 1985-1989. He has served on several governmental interagency panels on Materials Science, most recently as a team member assessing the potential for collaborative efforts between the U.S. and China. He was a co-principal investigator on an experiment that flew in the Materials Experiment Apparatus on the D-1 mission. Prior to working in NASA Headquarters, he had been at the Langley Research Center since 1962. His last position there was group leader of a research group investigating the effects of convection on semiconductor properties. He was a principal investigator in the MSAD flight program from 1977-1985. He has done research in various types of semiconductor crystal growth, electrical and optical properties of materials, electronic devices for remote sensing and flat panel displays and heat shield protection for reentry space vehicles. He trained as the Alternate Payload Specialist on STS-42 (First International Microgravity Laboratory). Most recently, he flew as a payload specialist on STS-83, April 4-8,1997. STS-83, the Microgravity Science Laboratory (MSL-1) Spacelab mission, was cut short because of problems with one of the Shuttle's three fuel cell power generation units. Mission duration was 95 hours and 12 minutes, traveling 1.5 million miles in 63 orbits of the Earth.

PUBLICATIONS:

Published over 40 technical papers and more than 40 technical presentations in various areas of research, concentrating since 1978 on semiconductor crystal growth and the influence of gravitational forces on materials properties.

SPECIAL HONORS:

Floyd Thompson Fellowship 1979; Quality Increase 1972, 1986, 1988; Exceptional Service Award 1989; Outstanding Performance Rating, 1985, 1986, 1987, 1989, Certificates of Recognition 1973, 1975, 1976, 1977, 1979, 1980, 1981, 1984 (2), 1985,1986, 1987 (3), Special Achievement Award, 1983, Sustained Superior Performance Award, 1989, Superior Accomplishment Award 1992, NASA Exceptional Achievement Medal 1995.

ORGANIZATIONS:

Member of American Physical Society, American Association for Crystal Growth, Sigma Pi Sigma, Kappa Mu Epsilon.

CURRENT ASSIGNMENT:

Dr. Crouch will serve as a payload specialist. on STS-94. The 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997 aboard Space Shuttle Columbia.

Gregory T. Linteris: STS-94 Payload Specialist-2
(Ph.D.)

PERSONAL DATA:
Born October 4, 1957, in Demarest, New Jersey, where his parents, Lino Luigi Linteris and Helen Mary Linteris reside. Single. Recreational interests include running, skiing, board sailing, hiking, backpacking, and reading, and was a member of Princeton's wrestling team.

EDUCATION:
Graduated from Northern Valley Regional High School at Demarest, New Jersey in 1975; received a bachelor of science degree in chemical engineering from Princeton University in 1979; obtained a master of science degree from the design division of the mechanical engineering department at Stanford University in 1984; and was awarded a doctorate in mechanical and aerospace engineering from Princeton University in 1990.

ORGANIZATIONS:
Member of American Institute of Aeronautics and Astronautics, American Physical Society, Combustion Institute, Sigma Xi.

PUBLICATIONS:
Dr. Linteris has over 40 publications in the areas of combustion, chemical kinetics, spectroscopy, and heat transfer.

SPECIAL HONORS:
Graduated with honors from Princeton University (1979). Awarded a Mechanical Engineering Department Fellowship from Stanford University (1983), and received Fourth Place in the James F. Lincoln National Design Competition (1984). At Princeton, he was the recipient of a Guggenheim Fellowship (1985), a Grumman Prize for excellence in Research (1988), and the Luigi Crocco Award (1988) for outstanding performance as an Assistant in Instruction.

EXPERIENCE:
At Princeton from 1985 to 1990, Dr. Linteris studied the high temperature chemical kinetics of combustion reactions in a turbulent chemical kinetic flow reactor using laser induced fluorescence and laser absorption. As a research staff member at the University of California, San Diego, from 1990 to 1992, he studied droplet dynamics and performed numerical and analytical modeling of the chemistry important in the gas-phase reaction region of solid rocket propellants. Since 1992 he has been at the National Institute of Standards and Technology where he has been developing a research program on advanced fire suppressants and studying the inhibition mechanisms of chemical inhibitors. He is Principal Investigator on a NASA microgravity combustion experiment: "Chemical Inhibitor Effects on Diffusion Flames in Microgravity." Most recently, Dr. Linteris flew on STS-83, April 4-8, 1997. STS-83, the Microgravity Science Laboratory (MSL-1) Spacelab

mission, was cut short because of problems with one of the Shuttle's three fuel cell power generation units. Mission duration was 95 hours and 12 minutes, traveling 1.5 million miles in 63 orbits of the Earth.

CURRENT ASSIGNMENT:

Dr. Linteris will serve as a payload specialist on STS-94. The 16-day re-flight of the Microgravity Science Laboratory (MSL-1) Spacelab mission will focus on materials and combustion science research in microgravity. Launch is scheduled for the Summer of 1997 aboard Space Shuttle Columbia.

News Release

National Aeronautics and
Space Administration

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For Release

July 1, 1997

RELEASE: 97-148

HUBBLE'S LOOK AT MARS SHOWS CANYON DUST STORM, CLOUDY CONDITIONS FOR PATHFINDER LANDING

Hubble Space Telescope pictures of Mars, taken on June 27 in preparation for the July 4 landing of the Pathfinder spacecraft, show a dust storm churning through the deep canyons of Valles Marineris, just 600 miles (1000 km) south of the Pathfinder spacecraft landing site.

"Unless the dust storm were to evolve into a massive, global event, its effects on the Pathfinder mission should be minimal," says Steve Lee of the University of Colorado in Boulder. "This is something we did not expect to see."

The Hubble astronomers also report the presence of patchy cirrus clouds over the landing site and very thick clouds to the north. Since there are so many clouds (related to low temperatures in the atmosphere causing water vapor to freeze), the dust will probably stay confined to the canyons, they conclude.

If dust rises to the elevations where the water-ice clouds form, ice condenses on dust grains and the heavier ice/dust particles quickly fall back out of the atmosphere. ~~Though the dust could extend at low altitudes over the landing site, researchers say current prevailing winds should take the dust northward.~~ See next page 97-150

"If dust diffuses to the landing site, the sky could turn out to be pink like that seen by Viking," says Philip James of the University of Toledo. "Otherwise, Pathfinder will likely show blue sky with bright clouds."

-more-

The imaging team includes Steve Lee of the University of Colorado at Boulder's Laboratory for Atmospheric and Space Physics; Todd Clancy of Boulder's Space Science Institute; Phillip James of the University of Toledo; Mike Wolff of the Space Science Institute; and Jim Bell of Cornell University.

-end-

EDITOR'S NOTE: The image is available via the Internet at URL:

http://oposite.stsci.edu/pubinfo/PR/97/23.html

News Release

National Aeronautics and
Space Administration

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For Release

July 2, 1997

RELEASE: 97-149

NASA'S EARTH SCIENCE PROGRAM ADJUSTS TO LOSS OF DATA FROM JAPANESE ADEOS SATELLITE

"The failure of Japan's Advanced Earth Observing Satellite (ADEOS or Midori) spacecraft with the two NASA instruments aboard it is a real blow to NASA's science program," said Mike Mann, Deputy Associate Administrator, NASA's Mission to Planet Earth Strategic Enterprise, Washington, DC.

"Fortunately, much of the ozone data provided by the Total Ozone Mapping Spectrometer (TOMS) science instruments aboard ADEOS can be provided by instruments on another spacecraft. However, the sea-surface winds data provided by the NASA Scatterometer (NSCAT) will be harder to replace and were opening essentially new opportunities for research and operational users worldwide," Mann said.

The two NASA instruments were aboard the ADEOS spacecraft, which on June 30 was declared lost by the National Space Development Agency of Japan (NASDA).

"The collaboration between NASDA and NASA on this mission has been outstanding and is reflective of the great partnership that exists between Japan and the U.S in the area of global change research," Mann said.

"NASDA has performed in an exemplary and open manner in the development of the spacecraft and in dealing with us. However, space operations is a risky business; those of us involved in the business strive to limit the risk but sometimes mishaps do occur," Mann said.

-more-

"The data we have obtained to date are extremely valuable," said Jim Graf, NSCAT project manager at NASA's Jet Propulsion Laboratory, Pasadena, CA. "If we knew we were limited to just nine months of data, we would have chosen the period we actually got. We obtained coverage over the summer and winter monsoon seasons and what may be the onset of an El Nino. Perhaps the largest loss is the discontinuity of the long-term data set, which is being used to understand interannual and decadal variations in our climate."

The scatterometer measured wind speed and direction over the world's oceans. The data set is extremely valuable and versatile and is being used by climate change researchers, operational weather forecasters, and commercial ship routing firms. During its flight, the instrument gathered 42 weeks' worth of data.

Within a very few short months after launch, the value of ADEOS data was seen in U.S. weather forecasting. "NOAA had begun using ocean surface wind products, derived from NSCAT, in weather forecasting," said Helen Wood, Director, Office of Satellite Data Processing and Distribution, National Oceanic and Atmospheric Administration. "Ocean surface wind measurements are used in numerical weather prediction models and help forecasters more accurately determine the path and intensity of tropical storms and hurricanes."

Because this instrument provided measurements that will be needed over the long term, NASA was already developing a second scatterometer instrument to continue this vital data set. That instrument, called "SeaWinds," will be delivered to NASDA for integration on the spacecraft next April and is scheduled for launch in 1999 on ADEOS II.

The launch of a Total Ozone Mapping Spectrometer sensor aboard ADEOS was helping to extend the unique data set of global total column ozone measurements begun by a similar instrument carried aboard NASA's Nimbus-7 satellite in 1978 and extended until December 1994 with the Meteor-3 TOMS.

"The ADEOS spectrometer, along with the TOMS Earth Probe (EP) instruments also observed the unusual loss of Arctic polar ozone reported earlier this year," said Dr. Arlin J. Krueger, Principal Investigator and Instrument Scientist for TOMS/ADEOS at NASA's Goddard Space Flight Center, Greenbelt, MD.

Although it also provided ozone coverage, NASA's Total Ozone Mapping Spectrometer/Earth Probe instrument had also been providing high ground resolution research data to complement the global data of the spectrometer on ADEOS. As a result, its orbit is different than TOMS/ADEOS. The EP satellite has adequate fuel to raise its present 500 km orbit to an orbit near the 800 km ADEOS orbit, where contiguous Earth coverage is possible for monitoring of ozone and volcanic eruption clouds. NASA is considering raising TOMS/EP to a higher orbit.

With this adjustment, much more complete global coverage of total ozone measurements previously provided by TOMS/ADEOS could be received. However, some of the unique smaller-scale aerosols and ozone research being done by TOMS/EP would be lost. The next Total Ozone Mapping Spectrometer mission is planned for launch on a Russian Meteor-3M spacecraft in 2000.

The loss of the ADEOS platform has a particularly serious impact on oceanographic research since two instruments, the Ocean Color and Temperature Sensor and the Polarization and Directionality of the Earth's Reflectance, both capable of providing routine global estimates of phytoplankton pigment concentrations, were lost. These instruments were providing the first routine global observations of ocean color and were initiating the much-needed, long-term time series of such measurements for global change studies.

Future routine global ocean-color information will be provided by SeaWIFS, a commercial mission from which NASA will purchase data, currently scheduled for launch July 18.

The NASA Scatterometer and Total Ozone Mapping Spectrometer/ADEOS were developed under NASA's strategic enterprise called Mission to Planet Earth, a comprehensive research effort to study Earth's land, oceans, atmosphere, ice and life as an interrelated system.

NASA is cooperating with NASDA to identify the cause of the ADEOS failure and recommend a solution for future missions.

-end-

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

Don Savage
Headquarters, Washington, DC
(Phone: 202/358-1547)

Tammy Jones
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-5566)

Ray Villard
Space Telescope Science Institute, Baltimore, MD
(Phone: 410/338-4514)

For Release
July 1, 1997

RELEASE: 97-150

CORRECTION TO RELEASE 97-148: HUBBLE'S LOOK AT MARS...

In the subject release, the last sentence in the fourth paragraph should read: "Though the dust could extend at low altitudes over the landing site, researchers say current prevailing winds should not take the dust northward."

-end-

Internet Advisory

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release

Brian Dunbar
Headquarters, Washington, DC
(Phone: 202/358-0873)

July 9, 1997

Rich Pavlovsky
Jet Propulsion Laboratory
(Phone: 818/354-5952)

RELEASE: I97-8

PATHFINDER GETS HIT HARD ON THE INTERNET

Preliminary analysis of Mars Pathfinder Web sites show a steady stream of 45 million hits per day following the NASA spacecraft's landing on July 4. Project officials estimate the sites will have taken 265 million hits by midnight PDT July 9.

On landing day, the 17 sites took approximately 30 million hits, and they have had a relatively constant level of activity since then.

The primary Pathfinder Web server, at

http://mpfwww.jpl.nasa.gov

has 17 reflectors around the world to try to provide quick access to information to a global audience.

Webmasters at NASA's Jet Propulsion Laboratory caution that these figures are preliminary and may be revised.

-end-

Video Advisory

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

For Release
July 9, 1997

VIDEO ADVISORY: V97-66

MORE FROM MARS ALL THIS WEEK ON NTV

Through Friday, July 11, NTV has scheduled several opportunities each day to disseminate the latest images and information from the Mars Pathfinder mission. The first release of news from the red planet will be during the daily Mars Pathfinder briefing, with a post-feed of the latest B-roll material. Both the briefing and B-roll feed will be replayed each day at 9 p.m. Eastern (6 p.m. Pacific.)

The most recently combined NTV schedule, including briefings and commentary for STS-94 and Mars Pathfinder, Video Files and Mir status reports, can be found on World Wide Web at:

ftp://ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked/tvsked.txt

or via FTP:

ftp.hq.nasa.gov
(user ID) type "anonymous" (without quotes)
(password) type your e-mail address
(directory) type "/pub/pao/statrpt/jsc/tvsked" (without quotes)
download the file "tvsked.txt"

This schedule will be updated as events warrant. No further Video Advisories are planned for this week.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
Space Administration

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Eileen Hawley
Johnson Space Center, Houston, TX
(Phone: 281/483-5111)

For Release

July 9, 1997

RELEASE: 97-151

JEFF HOFFMAN RETIRES FROM ASTRONAUT CORPS

Veteran astronaut Jeffrey A. Hoffman (Ph.D.) is leaving the Astronaut Corps after five Space Shuttle flights to become NASA's European representative in Paris, France.

"Jeff's contributions over the past 19 years have been extremely valuable to the astronaut corps, and we will certainly miss him," said David C. Leestma, director of flight crew operations at NASA's Johnson Space Center, Houston, TX. "We are pleased that he will continue to provide his expertise to the Agency in his new role."

Hoffman was selected as an astronaut in 1978. On STS-51D in April 1985, he made the first contingency spacewalk of the Space Shuttle era, attaching a 'flyswatter' device to the Shuttle's robot arm in an attempted rescue of the Leasat satellite. He then flew on STS-35, a dedicated astronomy mission in December 1992 onboard Columbia. He was the payload commander for STS-46, the first flight of the Tethered Satellite System in July 1992, and flew again on STS-75 in March 1996 for the Tethered Satellite reflight. Hoffman also was one of four spacewalking astronauts for the first Hubble Space Telescope servicing mission in 1993 during the STS-61 mission. In his five space flights, Hoffman has logged more than 1,200 hours in space and traveled more than 21.5 million miles.

In his new position, Hoffman will be responsible for monitoring the implementation of NASA policies and relationships with the European space and aeronautical communities, as well as governmental, industrial and academic institutions.

For complete biographical information on Hoffman, or any astronaut, see the NASA Internet biography home page at URL:

http://www.jsc.nasa.gov/Bios/

-end-

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
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Sonja Alexander
Headquarters, Washington, DC
(Phone: 202/358-1761)

For Release

July 11, 1997

NOTE TO EDITORS: N97-46

NASA TO BRING THE EXCITEMENT OF SPACE EXPLORATION TO NAACP CONVENTION

NASA Administrator Daniel Goldin and a team of agency scientists and engineers will join the National Association for the Advancement of Colored People (NAACP) during the organization's annual convention on July 11-17 at the Pittsburgh Convention Center.

The NAACP will conduct its annual national Afro-Academic Cultural, Technological and Scientific Olympics (ACT-SO) competition during the convention. African-American students from various cities across the country will compete for national honors in 24 categories ranging from science and engineering to dance and the cultural arts. Nearly 30 NASA scientists and engineers will serve as judges for the scientific part of the competition. The national winners in the technical competitions will be presented certificates from the NASA Administrator as well as a sponsored visit to a NASA field center or an event such as a space shuttle launch.

ACT-SO, sponsored by the NAACP, encourages African-American students to excel in academic and cultural achievements. The first national ACT-SO competition was held in Portland, OR in 1978. A year-long program, ACT-SO is designed to recruit, improve and encourage academic and cultural achievement among African-American high school students. The local NAACP branches provide volunteers to mentor and conduct the local competitions. The top local winners then compete at the national finals during the annual NAACP convention.

NASA also will feature an exhibit of the Mobile Aeronautics Education Laboratory (MAEL). The MAEL is a 53-foot classroom trailer designed to demonstrate the use of technology in the teaching of mathematics and science. The MAEL was developed by NASA in conjunction with the Cuyahoga Community College in Cuyahoga, OH, to support science, engineering, mathematics and technology education. Some of the activities aboard the mobile teaching facility include a virtual reality lab, remote sensing concepts and the use of amateur radio.

-end-

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

Dwayne Brown
Headquarters, Washington, DC
(Phone: 202/358-1726)

For Release

July 14, 1997

Diane Spitaliere
Federal Aviation Administration, Washington, DC
(Phone: 202/267-8571)

NOTE TO EDITORS: N97-47

VICE PRESIDENT TO SHOWCASE AVIATION SAFETY TECHNOLOGIES DEVELOPED BY NASA AND FAA

Vice President Gore on Tuesday, July 15, at Dulles International Airport, will showcase aviation safety technologies developed by NASA and the FAA. The event is scheduled to begin at approximately 12:50 pm EDT at Dulles' United Terminal, Gate C-1. The technologies are examples of the cooperative work between NASA and the FAA.

The Vice President, accompanied by Department of Transportation Secretary Rodney Slater and NASA Administrator Daniel S. Goldin, will conduct actual "hands on" demonstrations of the new technologies in a NASA 757 research aircraft that will be parked at the gate, in addition to technologies that will be featured in the gate area.

Media representatives should be prepared to display standard press ID. Press credentialing will be conducted on-site. To assist media in transportation to Dulles, a bus will leave from NASA Headquarters (300 E Street SW) at 10:30 am for the airport and will depart Dulles at approximately 2:30 pm, returning to NASA. Media wishing to take the bus should contact NASA or the FAA as soon as possible to reserve a seat. Media furnishing their own transportation are requested to go to the east end of the main terminal to Shuttle dock number 5. The Dulles "people mover" will depart for the United terminal starting at 11:30 a.m.

- end-

News Release

National Aeronautics and
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Washington, DC 20546
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Donald Nolan
Headquarters, Washington, DC
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For Release
July 14, 1997

RELEASE: 97-152

NASA ANNOUNCES 1997 STTR PHASE I SELECTIONS

Fifty research proposals have been selected by NASA's Office of Aeronautics and Space Transportation Technology for immediate negotiation of Phase I contracts in the agency's 1997 Small Business Technology Transfer Program (STTR).

The 1997 Phase I solicitation closed on April 22, 1997. More than 200 separate proposals were submitted by small, high-technology businesses from all sections of the United States. Research topics included in this solicitation were Earth remote sensing; advanced technology for space science; human exploration and development of space; general aviation; advanced space transportation; and nondestructive evaluation of material properties and structural integrity.

All proposals were peer-reviewed for both technical merit and commercial potential. Selections were based on the following four evaluation criteria: scientific or technical merit and feasibility of the proposed cooperative research effort; experience and qualification of the small business concern; effectiveness of the proposed organization and plans for accomplishing the goals of the cooperative research; and commercial merit and feasibility of the proposed research.

The STTR program requires small business concerns to conduct cooperative research and development by partnering with a research institution. At least 40 percent of the work must be performed by the small business concern, and at least 30 percent of the work must be performed by the research institute.

The objective of a Phase I project is to determine the feasibility of the proposed research. Each of the 50 selected proposals will be awarded a fixed-price contract valued at up to $100,000 with one year to complete the Phase I projects. Companies that successfully complete Phase I activities are eligible to compete for Phase II awards the following year. The Phase II award process allows for two-year, fixed-price contracts up to $500,000.

EDITOR'S NOTE: A listing of companies selected for this program and a breakdown of awards by state and NASA center are available via the Internet at URL:
ftp://ftp.hq.nasa.gov/pub/pao/pressrel/1997/97-152a.txt

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News Release

National Aeronautics and
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For Release

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Headquarters, Washington, DC
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July 14, 1997

Fred Brown
Dryden Flight Research Center, Edwards, CA
(Phone: 805/258-2663)

Eric Dunn
Pacific Missile Range Facility, Kekaha, Kauai, Hawaii
(Phone: 808/335-4560)

RELEASE: 97-153

SOLAR-POWERED PATHFINDER SETS NEW RECORD; PREPARES TO MONITOR DEFORESTATION OF HAWAIIAN ISLAND

A sleek flying remotely piloted vehicle named Pathfinder set a new unofficial world record for high-altitude flight by a solar-powered aircraft at the U.S. Navy Pacific Missile Range Facility, Kauai, Hawaii. The new mark of over 71, 500 feet set last week exceeds Pathfinder's previous record of 67,350 feet set in June 1997. Pathfinder is now being prepared to monitor coral reef degradation and deforestation around the island of Kauai.

"The altitude achievement, a major milestone for the program, demonstrates the aircraft's capability to carry scientific payloads and other experiments into the upper atmosphere," said Jennifer Baer-Riedhart, Project Manager for NASA's Environmental Research Aircraft and Sensor Technology program at the Dryden Flight Research Center, Edwards, CA.

Remotely piloted aircraft similar to Pathfinder could spend long periods of time over the ocean monitoring storm developments to provide more accurate predictions of hurricanes. These aircraft also could be used to monitor major croplands, forests and other large, remote expanses to provide early warning of crop damage or fires. The payloads for demonstration flights for the program are supplied by NASA's Ames Research Center, Moffett Field, CA.

-more-

The program is NASA's response to growing scientific requirements for measurements at higher altitudes and durations than the current fleet of scientific platforms permits. Additional technologies considered by the joint NASA-industry alliance include lightweight materials, avionics, sensor technology, aerodynamics, and other forms of propulsion suitable for extreme altitudes. Pathfinder is one of several remotely piloted aircraft being evaluated under the program. The program focuses on developing technologies required to operate slow-flying unpiloted aircraft at high altitudes. The most extreme mission envisioned for solar-powered aircraft would reach altitudes of 100,000 feet for environmental sampling missions that last a week or longer.

Pathfinder is a flying wing (with a span of 99 feet), with two small pods that extend below the wing's center section, that can carry a variety of scientific sensors. The solar arrays on the wing can provide as much as 7,200 watts of power at high noon on a summer day to power the craft's six electric motors and other electronic systems. A backup battery system can provide power for up to five hours to fly the craft after sundown. Pathfinder was designed, manufactured and is operated by AeroVironment, Inc., of Simi Valley, CA, under a jointly sponsored research agreement with NASA.

Pathfinder's record-breaking flight occurred on July 7, with a takeoff at 2:34 p.m. EDT. After completion of low-level system checks, Pathfinder began climbing. Just after 8:45 p.m. EDT, it passed its previous altitude record. The aircraft continued to climb to over 71,500 feet before mission controllers decided to bring the craft back to Earth. Pathfinder completed its mission with a perfect landing at 5:05 a.m. EDT.

The record is the highest altitude ever attained by a propeller-driven aircraft. Before Pathfinder, the altitude record for propeller-driven aircraft was 67,028 feet set by the experimental Boeing Condor remotely piloted aircraft.

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NOTE TO EDITORS: Still photos to support this release are available from the Dryden Public Affairs Office. Photos also are available on the Internet under NASA Dryden Research Aircraft Photo Archive, Dryden News and Feature Photos, at URL:

http://www.dfrc.nasa.gov/gallery/photo

NASA Dryden news releases also are available on the Internet at URL:

http://www.dfrc.nasa.gov/PAO/PressReleases/index.html

Video Advisory

National Aeronautics and
Space Administration

Washington, DC 20546
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Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

For Release
July 15, 1997

VIDEO ADVISORY: V97-67

VICE PRESIDENT SHOWS OFF AVIATION SAFETY TECHNOLOGIES

Vice President Gore will showcase aviation safety technologies that are being designed and tested for use in commercial aircraft and airports. These innovations are examples of the cooperative work between NASA and the Federal Aviation Administration.

ITEM 1: SAFETY IN THE SKIES

ITEM 1a: SMART AIRPLANES

Airplanes suffering major equipment failures or explosions can land safely using this new software.

ITEM 1b: COCKPIT WEATHER

NASA has developed a system providing pilots with up-to-date weather information in the cockpit.

ITEM 1c: AIRPORT TAXI

Taxiway navigation and situation awareness is the goal of the T-NASA system which will help pilots taxi more efficiently.

ITEM 1d: SEVERE WEATHER TESTS

Simulated lightning in a wind tunnel could lead to great flight safety.

ITEM 1e: WEATHER-PIERCING CAMERA

Increased visual clarity may reduced air traffic delays due to poor visibility.

ITEM 1f: FINAL APPROACH SPACING TOOL

New software could help air traffic controllers reduce delays up to 20 percent.

For more information contact Dwayne Brown at (202) 358-1726.

Video news file today at noon, 6, 9 p.m. and midnight EST.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

Beth Schmid
Headquarters, Washington, DC
(Phone: 202/358-1760)

For Release

July 16, 1997

RELEASE: 97-154

SOFTWARE USED ON MARS PATHFINDER WINS NASA'S SOFTWARE OF THE YEAR AWARD

Frederick D. Gregory, NASA's Associate Administrator for Safety and Mission Assurance, and Dr. Daniel R. Mulville, NASA Chief Engineer and Chair of the agency's Inventions and Contributions Board, have selected a software program used on the Mars Pathfinder mission as the winner of the 1997 NASA Software of the Year Award.

Dr. Abhinandan Jain, Dr. Guillermo Rodriguez, and Dr. Guy K. Man of NASA's Jet Propulsion Laboratory, Pasadena, CA, developed the software called DARTS: Dynamics Algorithms for Real-Time Simulation. The DARTS software can be used to generate real-time simulations to test and verify flight software and hardware for a variety of spacecraft missions. NASA engineers calculate phenomenal improvements in simulation speed and fidelity -- of up to ten million times -- which is the result of the use of a brand new form of mathematics, known as Spatial Operator Algebra. The team received an award for development of the new algebra three years ago. In addition to Mars Pathfinder, this software has been used on the Cassini, Galileo, Stardust, New Millennium and Neptune Orbiter missions.

The winning software has saved over $10 million to date on NASA missions. NASA will present the award at the Technology 2007 Conference to be held in Boston, MA, on September 23, 1997. Information about this software is available on the Web at URL:

www.hq.nasa.gov/office/codei/swy97win.html

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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Sonja Alexander
Headquarters, Washington, DC
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For Release
July 17, 1997

NOTE TO EDITORS: N97-48

MARS ROVER CONTEST WINNER AVAILABLE FOR MEDIA INTERVIEWS

Valerie Ambroise, 15, the writer of the winning essay naming the Mars Pathfinder rover, Sojourner, will be available for media interviews at 9:30 a.m. EDT, Friday, July 18, at the National Air and Space Museum, Washington, DC. To arrange an interview, please call NASA at 202/358-1761.

A team of judges from NASA Headquarters, NASA's Jet Propulsion Laboratory and the Planetary Society, conducted a year-long, worldwide competition in 1995. In July of that year, Ambroise's essay was chosen out of 3,500 entries.

The Sojourner rover is named after the Civil War era African-American woman, Sojourner Truth, who traveled throughout the country supporting the rights of all people to be free.

Next week, a sweeping 360-degree color panorama of the Martian landing site, taken by the camera on the Mars Pathfinder's Carl Sagan Memorial Station, will go on display at the National Air and Space Museum's Milestones of Flight Hall. The image shows features ranging from rocks near the lander to more distant objects, such as hills on the horizon.

-end-

Video Advisory

National Aeronautics and
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Washington, DC 20546
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Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

For Release
July 18, 1997

VIDEO ADVISORY: V97-68

MAKE NO BONES ABOUT IT: ASSESSING OSTEOPOROSIS RISK

On Friday, NASA TV will show animation and footage of a portable device that could help assess a person's risk of osteoporosis due partly to an inactive lifestyle. This device is being developed for the space program at the NASA Ames Research Center to examine how physical activity relates to bone density, an important factor in osteoporosis. Also on NASA TV at 1 p.m. Eastern, a five-minute historical look at NASA's Langley Research Center, in celebration of its 80th anniversary on July 19.

ITEM 1: BONE SHAKING RESEARCH
Animation of a human skeleton and b-roll of the portable device in use.

ITEM 1a: INTERVIEW - GREGORY BREIT, RESEARCH ENGINEER

ITEM 1b: INTERVIEW - ROBERT WHALEN, RESEARCH SCIENTIST

For more information contact Mike Braukus at (202)358-1979 or Ann Hutchison at (415) 604-4968.

Video news file today at noon, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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Michael Braukus
Headquarters, Washington, DC
(Phone: 202/358-1979)

For Release

July 18, 1997

Ann Hutchison
Ames Research Center, Moffett Field, CA
(Phone: 415/604-4968)

RELEASE: 97-155

NASA TECHNOLOGY MAY HELP ASSESS RISK OF BONE PROBLEMS

A portable device developed for the space program to examine how physical activity relates to bone density may someday serve as a way to assess a person's risk of osteoporosis.

The device, developed by researchers in the Life Sciences Division at NASA's Ames Research Center, Moffett Field, CA, provides a record of the major forces people apply to their bodies throughout the day. It does this by measuring and recording the interaction between the foot and the ground during daily activity. This "loading" of the body plays an important role in maintaining muscle and bone strength in the lower limbs.

"This device was designed to quantify daily physical activity and daily musculoskeletal loading by measuring the ground-reaction force," said Dr. Robert Whalen, head of the Musculoskeletal Biomechanics Laboratory in the Gravitational Research Branch at Ames. The device measures the force that occurs on the foot during each step. The force can reach one and one-half times a person's body weight during walking and two to three times body weight during running. "It's very important to monitor this force throughout the day because it also is responsible for high muscle and bone forces in the legs and critical bone regions such as the hip and pelvis," Whalen explained.

The force exerted on the body when it meets the ground is what keeps muscles and bones in the lower body strong. If muscles and bones aren't used, they become significantly weaker, a problem encountered by astronauts during space flight, particularly by astronauts who do not exercise vigorously in space. "Maintaining muscles and bones during long duration space flight is primarily a biomechanical problem," Whalen said. "With current in-flight exercise devices, it is difficult to achieve force levels equivalent to levels achieved during normal daily activity on Earth. We are investigating new ways to counteract these changes with devices capable of imposing Earth-equivalent levels of force on the body in space."

-more-

Whalen and Dr. Gregory Breit, researchers at Ames, are studying the relationship between the mechanical forces humans put on the skeleton every day and the structure of the skeleton. "Bone is highly responsive to mechanical forces," Breit said. "That may be the key to understanding why bone is lost gradually with age and why certain exercise programs can't build bone mass," Whalen added.

The key, Whalen explained, is determining how individuals can "load" their bodies to maintain muscle and bone strength. Since our muscles generate their own forces, we are limited by how strong our muscles are. "If you don't have the muscle strength, you can't exert high forces on bones to increase bone mass," Whalen said. "As people age, a gradual decline in activity level and intensity contributes to a decline in muscle strength, and therefore our ability to load our bones also decreases." The result can be less dense, weaker bones that are more prone to fractures.

The device consists of two elements: a force sensor resembling an insole that is worn in the shoe, and a small computer carried in a fanny pack. A cable connects the sensor to the small computer, which samples the applied force 100 times per second. It stores only the significant maximum and minimum forces occurring during each loading or gait cycle, as well as the peak loading and unloading rate and the time at which each event occurred. The device is capable of storing approximately two weeks of activity data.

Although scientists have used step-meters and activity logs to estimate a person's daily activity level and musculoskeletal loading history, Whalen said these devices don't give a reliable measurement of forces on the skeleton, due to differences among people and differences in the amount and "intensity" of their daily activities. A person walking quickly will generally experience higher forces than when walking more slowly, for example. The new device provides a reliable measure of the actual forces exerted on the body.

The Ames researchers are collaborating with the Palo Alto Veterans Administration Hospital and with Stanford University, Palo Alto, CA, to study how daily activity level and exercise influence bone density. "Once we have enough data, we can get an idea of the daily physical activity level of an 'average' person," Breit said. "Then people can decide if they are above or below average and what they need to do to improve. In the future, we hope to understand bone adaptation well enough to assess whether an individual's bone density is consistent with his or her daily activity level."

Breit said that this device will allow measurement of an individual's activity to assess his or her risk of low bone density from low physical activity level and will allow an individual exercise prescription to improve the health of an older person.

For photographs or more information about the Musculoskeletal Biomechanics Laboratory, visit the Web site at URL:

http://pioneer.arc.nasa.gov/~rwhalen/

-end-

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

For Release

Douglas Isbell
Headquarters, Washington, DC
(Phone: 202/358-1753)

July 21, 1997

RELEASE: 97-156

NASA STATEMENT ON THE PASSING OF GENE SHOEMAKER

Planetary scientist Dr. Eugene ("Gene") Shoemaker, 69, was killed in a two-car accident near Alice Springs, Australia, on the afternoon of July 18. His wife Carolyn Shoemaker suffered broken bones, and reportedly is hospitalized in stable condition.

A geologist by training, Shoemaker is best known for discovering, with his wife Carolyn and colleague David Levy, a comet near Jupiter. Comet Shoemaker-Levy 9 was broken up by tidal forces from Jupiter, and its fragments collided with the planet in July 1994. Together, the Shoemakers were the leading discoverers of comets this century.

"Gene was one of the most renowned planetary scientists in the world, and a valued member of the NASA family since the earliest days of lunar exploration," said NASA Administrator Daniel S. Goldin. "His work on the history of meteor impacts and the role that they play in the evolution of the Solar System is a fundamental milestone in the history of space science.

"Gene was an extremely articulate man who could explain the wonders of the planets in simple language that anyone could understand and get excited about," Goldin added. "Although he never realized his dream of doing field geology on the surface of the Moon, all future exploration of that rocky world owes a debt to his pioneering spirit. Our warmest thoughts are with his dear wife Carolyn as she recovers from her injuries."

Shoemaker's signature work was his research on the nature and origin of the Barringer Meteor Crater near Winslow, AZ, which helped provide a foundation for cratering research on the Moon and planets. This work led to the establishment of a lunar chronology, allowing the dating of geological features of its surface.

Shoemaker took part in the Ranger lunar robotic missions, was principal investigator for the television experiment on the Surveyor lunar landers (1963-1968), and

-more-

led the geology field investigations team for the first Apollo lunar landings (1965-1970). In 1961, he organized the Branch of Astrogeology of the U.S. Geological Survey in Flagstaff, AZ, and acted as its director from 1961 to 1966. On his retirement from the U.S.G.S. in 1993, Shoemaker became a staff member at Lowell Observatory in Flagstaff.

An early supporter of the idea that an asteroid or comet impact had doomed much of Earth's life (including the dinosaurs) 65 million years ago, Shoemaker chaired key NASA working groups on how best to survey such near-Earth objects in 1981 and 1994. Most recently, he was active in the Clementine mission that imaged the Moon, and was science team leader on the planned Clementine 2 mission.

Shoemaker won numerous awards during his career, and in 1980 became a member of the National Academy of Sciences.

-end

Video Advisory

National Aeronautics and
Space Administration
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For Release
July 22, 1997

Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

VIDEO ADVISORY: V97-69

LANDSAT'S 25TH: HERE'S LOOKING AT YOU

On Tuesday, NASA TV will show an anniversary b-roll package for the Landsat satellite program. Developed by NASA and launched in 1972, Landsat has provided imagery of the Earth -- creating a unique resource for global change research, agriculture and more.

ITEM 1: LANDSAT: 25 YEARS OF EARTH EXPLORATION
ITEM 1a: RONDONIA, BRAZIL
Landsat images taken 6/75, 8/86, 6/92, showing deforestation of rain forests.
ITEM 1b: KUWAIT
Images of oil fires taken 8/90, 2/91, 11/91.
ITEM 1c: GREAT SALT LAKE, UTAH
Shows the dramatic increase of the lake's surface area which caused flooding.
ITEM 1d: UPPER MISSISSIPPI RIVER BASIN
Images of 9/92, 9/93 and 10/93 show the seasonal rains that caused the Missouri River to flood.
ITEM 2: TWO'S A CROWD: LANDSAT SINGLE IMAGES
Includes South Florida, New York City, Salton Sea, CA, and San Francisco Bay.
ITEM 3: ANIMATION - EXPLORING ANCIENT ICE
Animation created from data and images depicts travel through Glacier Bay, AK.
ITEM 4: ANIMATION - LANDSAT 7
Animation of the current Landsat program scheduled for launch in 1998.
ITEM 5: HISTORICAL LANDSAT B-ROLL
Shows the first Landsat launch, July 23, 1972 from Vandenberg Air Force Base.
ITEM 6: INTERVIEW - COMPTON TUCKER, PHYSICAL SCIENTIST
ITEM 7: INTERVIEW - VINCENT SALOMONSON, EARTH SCIENCES DIRECTORATE PROGRAM MANAGER ON LANDSAT
For more information contact Doug Isbell at (202)358-1753.

Video news file today at noon, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

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John Bluck
Ames Research Center, Moffett Field, CA
(Phone: 415/604-5026)

For Release

July 24, 1997

RELEASE: 97-158

NEW AEROSPACE COMPUTER WILL REVOLUTIONIZE THE DESIGN AND CONSTRUCTION OF AIRPLANES

A NASA computer network tool promises great savings in time and money for airplane makers and the government by providing faster access to information to help shorten the aircraft design and test process by about 25 percent.

Called "Darwin," the network will revolutionize the way airplanes are developed by using wind tunnels linked with computers that send nearly instant test results via a network to geographically separated companies and laboratories.

Wind tunnels are chambers through which air flows during tests of airplane shapes. In the tunnels, air is blown around airplane and rocket models to simulate flight. "With Darwin, we're helping reduce the aerospace design cycle time by around a quarter, and we're providing information access to cut the number of independent design cycles," said Dr. David Korsmeyer, deputy project manager at NASA's Ames Research Center, Moffett Field, CA. "Our purpose is to get results and data out of NASA wind tunnels faster. Previously, such knowledge had to be derived by scientists and engineers in the days and months following wind tunnel tests," he said.

The key to Darwin's success is its ability to funnel wind tunnel data into a server computer, and then send knowledge back to researchers in "near real time" -- within about 30 seconds to five minutes. Darwin is similar to the Internet, but Darwin is not open to the public. The system is able to link NASA, aerospace industry and academic centers that may be located thousands of miles from one another. A computer program that many people use to browse the Internet from their home computers is used in the Darwin system.

-more-

Pressure gauges, strain gauges and other instruments attached to the models take readings while air blows through wind tunnels during experiments. Data streaming from the model instruments tell aerospace engineers how much lift, drag and maneuvering performance an airplane model can generate through different angles of flight, and at various speeds, altitudes and conditions.

New knowledge about airplane designs gained during wind tunnel tests helps engineers to decide if their ideas are working, or if design changes must be made before expensive, full-size prototype airplanes are built.

Aerospace models used in the tunnels often cost more than $1 million each because they must be exactly to scale, and they must be extensively instrumented. Running a large wind tunnel can cost tens of thousands of dollars per hour, with the exact cost depending upon the tunnel, the number of personnel needed, as well as any special equipment required. Engineers would prefer not to have to return to a tunnel for follow-up test cycles with modified airplane or spaceship models.

"Engineers use supercomputers to try to predict how new designs will work before an airplane model is built. That works fairly well for straight, level flight, but even that kind of analysis is not perfect. What happens during take-off and landing is especially difficult to predict with supercomputers because air turbulence occurs. The wind sneaks back around and does unexpected things," said Korsmeyer.

"We're talking about eight-hour runs on the fastest computers on Earth to simulate wind flow over just a piece of the wing. That's where wind tunnel testing comes in. Testing a model in a wind tunnel, you get actual physics because you have real wind blowing over a wing," he explained.

"Before we began to use large computer networks to deliver data, wind tunnel systems were very good at capturing data for later analysis, but they were not good at 'serving' the data," said Korsmeyer. "Now, Darwin collects data, and it is translated into a useable form. Darwin also can provide access to data for researchers where they want it. The system can distribute data to many places at once, and it is secure," he added.

"The kind of data Darwin can provide to researchers is in a standard format so people can easily understand the data. In addition to the normal graphs and charts engineers use, they also can step through images like frames of a movie to see changes of colorized air pressure and wind speed. You can see changes more easily than if you were to study each image individually," he said.

-end-

News Release

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For Release
July 24, 1997

RELEASE: 97-159

AUGUST 7 SELECTED FOR STS-85 SPACE SHUTTLE MISSION LAUNCH

Space Shuttle Program managers today set August 7 as the launch date for the next Shuttle mission, to deploy and retrieve a science satellite and test a small robotic arm identical to one that will be used on the International Space Station's Japanese Experiment Module.

The launch window for Space Shuttle Discovery extends for one hour, 39 minutes from 10:41 a.m. to 12:20 p.m. EDT. Nominal flight duration is 10 days, 20 hours, 24 minutes, putting the landing on Monday, August 18, at 7:05 a.m. EDT.

Discovery's crew, made up of Commander Curt Brown, Pilot Kent Rominger, Mission Specialists Jan Davis, Robert Curbeam and Steve Robinson and Canadian Payload Specialist Bjarni Tryggvason, will deploy the CRISTA-SPAS spacecraft for nine days of free-flying atmospheric studies and demonstrate the operational capability of the Japanese Remote Manipulator System and its Small Fine Arm.

"From a shirt-sleeve orbiting laboratory one month, to the study of Earth's atmosphere and future flight demonstrations to support the International Space Station the next, the diversity of the Space Shuttle system is once again ready to be demonstrated with STS-85," said Johnson Space Center Director George Abbey, who chaired the Flight Readiness Review from the Kennedy Space Center, FL.

STS-85 will be Discovery's 23rd flight in space, tying it with Columbia as the Orbiter with the most missions. It also will be the 86th Shuttle flight in the program's history.

- end -

Date: Fri, 25 Jul 1997 14:39:48 -0400 (EDT)
From: NASANews@hq.nasa.gov
Subject: NASA to Showcase New Activities at Upcoming Aircraft Fly-In Convention
Sender: owner-press-release@lists.hq.nasa.gov
To: undisclosed-recipients:;

Dwayne Brown
Headquarters, Washington, DC July 25, 1997
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NOTE TO EDITORS: N97-51

NASA TO SHOWCASE NEW ACTIVITIES AT
UPCOMING AIRCRAFT FLY-IN CONVENTION

"Boomers Turn 50" is NASA's theme for this year's Experimental Aircraft Association (EAA) fly-in convention in Oshkosh, WI, July 30 - August 5 -- considered one of the world's largest and most significant aviation events. Last year, more than 800,000 people attended and over 11,000 airplanes were displayed -- including 2,478 showplanes.

NASA will feature two large exhibit areas that will reflect the growth of the Agency's general aviation, space transportation and Small Business Innovation Research programs. The NASA theme recognizes both the 50th anniversary of the U.S. Air Force and the 50th anniversary of the breaking of the "sound barrier." One of the many highlights of the event will feature NASA's SR-71 aircraft conducting three fly-overs on Saturday, August 2. Additionally, NASA will conduct four aeronautics-related news events on August 1-2.

FRIDAY, AUGUST 1

NASA Aeronautics Vision: 11 a.m. EDT, NASA Forum Tent

NASA Administrator Daniel S. Goldin will outline objectives to ensure that NASA's work in science and technology sustains U.S. leadership in civil aeronautics and space. Goldin will discuss NASA's vision to revitalize general aviation -- enabling U.S. industry to deliver 10,000 aircraft annually within 10 years and 20,000 aircraft annually within 20 years.

Student Design Competition: 11:50 a.m. EDT, NASA Forum Tent

NASA and the Federal Aviation Administration(FAA) will present the winners of the third annual NASA/FAA National General Aviation Design Competition. The competition allows university engineering students to participate in a major national effort to rebuild the U.S. general aviation sector. Students will learn who takes the top prize and EAA president Tom Poberezny will announce a new EAA-sponsored "design, build and fly" category for 1998. Plaques and prize money will be presented by NASA Administrator Daniel S. Goldin and Acting FAA Administrator Barry L. Valentine. A "retrofit" award will be presented by Bruce Landsberg of the Aircraft Owners and Pilots Association's Air Safety Foundation.

Williams V-JET-II Introduction: 2 p.m. EDT, EAA West Ramp:

This informal news briefing will introduce an aircraft designed to demonstrate lightweight, quiet and affordable turbofan engine technology for future light aircraft. The Williams International V-JET-II is an outgrowth of the NASA-sponsored General Aviation Propulsion program, aimed at revitalizing general aviation. By agreement, the company will perform engine development work that results in a next-generation demonstrator turbofan that will power the V-JET-II in demonstrations by the year 2000. Participants will be NASA Administrator Daniel Goldin and Williams International Chairman Dr. Sam Williams.

SATURDAY, AUGUST 2

General Aviation News: Noon EDT, EAA Press Tent:

The NASA & FAA General Aviation Research and Development Media Briefing will include information on:

* A new FAA-led flight training curricula effort.
* Technology breakthroughs in crash survivability and in quiet, efficient propeller design.
* The national aviation safety initiative.
* An update on the FAA's Flight 2000 "free flight" demonstration.

Participants will include Dr. Robert Whitehead, NASA Associate Administrator for Aeronautics and Space Transportation Technology, and Guy Gardner, FAA Associate Administrator for Regulation and Certification.

To contact NASA public affairs personnel during the Oshkosh event, media representatives should call 414-235-8273/8276 .

News Release

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For Release

July 25, 1997

RELEASE: 97-160

SECOND U.S. SPACE STATION COMPONENT BEGINS LAUNCH PREPARATIONS

The first of two pressurized mating adapters for the International Space Station arrived today at the Kennedy Space Center, FL, from manufacturer McDonnell Douglas in Huntington Beach, CA.

A pressurized mating adapter is a cone-shaped connector that will be attached to Node-1, the space station's structural building block, during ground processing in Kennedy's Space Station Processing Facility. Node-1 with the adapter attached will be the first element of the Station to be launched aboard the Space Shuttle in July 1998.

The mating adapter will be the connection point between Node-1 and the U.S. financed, Russian-built Functional Cargo Block, which will be launched from Russia as the first Station element to be placed into orbit. The adapter will house Space Station computers and various electrical support equipment and eventually will serve as the passageway for astronauts between the node and the cargo block.

"PMA-1 brings with it the computers that are the intelligence for the node," said Glenn Snyder, Space Shuttle mission STS-88 payload manager. "We're looking forward to testing with those computers."

For processing at Kennedy, the adapter will undergo initial acceptance testing. Then, in early September, it will be mated to Node-1 and a series of integrated tests will be conducted.

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"We're pleased that the first mating adapter is now at Kennedy," added John Elbon, test integration leader for McDonnell Douglas. "It is the next of the three elements of flight hardware necessary for the STS-88 mission."

The second adapter, the final element of the STS-88 mission, is expected to arrive at Kennedy this October. It also will be attached to Node-1 in the processing facility. This second adapter will serve as a Space Shuttle docking port during the construction and resupply of the Space Station.

The asymmetrical open-ended cone-shaped pressurized mating adapters are about seven feet long, five feet in diameter at one end and nine feet in diameter at the other. Each adapter consists of five individually machined and welded aluminum ring forgings, thermal insulation blankets and 52 fittings for electrical connections. The outer covering is a double-wall aluminum sheet to protect the adapters from strikes by space particles.

Space Shuttle Endeavour, carrying Node-1 with the two attached adapters, is targeted for launch in July 1998, approximately two weeks after the Functional Cargo Block is launched from Russia.

-end-

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For Release

July 28, 1997

RELEASE: C97-h

NASA EXERCISES OPTION ON LOCKHEED MARTIN CONTRACT AT STENNIS SPACE CENTER

NASA has exercised a two-year priced option on a cost-plus-award-fee contract with Lockheed Martin Space Mission Systems & Services, Houston, TX, for operations at the Agency's John C. Stennis Space Center, MS. The total cost of the option period is $66,312,843, and the period covered is September 1, 1997 through August 31, 1999.

At Stennis, Lockheed Martin provides, manages and operates facilities, laboratories and related capabilities essential to the development and certification testing of large propulsion systems and components, including the Space Shuttle Main Engine. This includes conducting research and development in propulsion test technologies including cryogenics, high-pressure gas, metrology, advanced instrumentation and sensor systems and engine diagnostics.

The company also provides services that include conducting research and development technologies to support NASA goals in environmental systems, science and observations, technology applications development and commercialization of remote sensing, and to provide technical support services to NASA and the resident agencies at the center.

Stennis Space Center is NASA's lead center for rocket propulsion testing and for commercial remote sensing within the Mission to Planet Earth Enterprise. NASA also functions as the host agency for 30 other agencies residing at Stennis.

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News Release

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For Release

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July 29, 1997

Franklin O'Donnell
Jet Propulsion Laboratory, Pasadena, CA
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NOTE TO EDITORS: N97-52

NEXT MARS PATHFINDER BRIEFING SCHEDULED FOR JULY 31

An update on Mars Pathfinder's mission operations and science activities will be presented at a news briefing at 1 p.m. EDT on Thursday, July 31, originating from the Jet Propulsion Laboratory, Pasadena, CA.

Members of the science team will discuss topics including recent longer-distance, autonomous treks by the Sojourner rover and results from initial observations of the Martian atmosphere and its clouds.

The briefing will be carried live on NASA Television, with two-way question and answer capability for media at participating NASA centers. NASA Television is located on GE-2, transponder 9C at 85 degrees west longitude, vertical polarization, with a frequency of 3880 Mhz, and audio of 6.8 Mhz.

-end-

Video Advisory

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For Release
July 29, 1997

VIDEO ADVISORY: V97-70

NASA EXPLORES INNERSPACE - 10,000 LEAGUES UNDER THE SEAS

Today's video package helps explain how NASA scientists from the Goddard Space Flight Center will soon be able to study Earth's oceans from space. With the aid of the Sea-viewing Wide Field-of-View Sensor (SEAWiFS) scheduled for launch on a Pegasus-XL launch vehicle August 1, 1997, scientists will gain data on phytoplankton levels and the changes of the oceans over time.

ITEM 1: **ANIMATION - EXPLORING INNERSPACE FROM SPACE**
ITEM 2: **SEEING THE BIG PICTURE**
ITEM 3: **MEASURING SEASONAL CHANGE**
ITEM 3a: **NORTH ATLANTIC**
ITEM 3b: **INDIAN OCEAN**
ITEM 4: **COASTAL ZONE COLOR SCANNER IMAGES**
ITEM 4a: **IMAGE OF STATEN ISLAND, CONEY ISLAND AND SANDY HOOK**
ITEM 4b: **NORTHEAST PACIFIC OCEAN**
ITEM 4c: **GALAPAGOS ISLANDS**
ITEM 4d: **TASMANIA**
ITEM 4e: **UNITED STATES EAST COAST**
ITEM 5: **INTERVIEW - MARY CLEAVE, PROJECT MANAGER, SEAWIFS**
ITEM 6: **INTERVIEW - GENE FELDMAN, OCEANOGRAPHER, GODDARD**
ITEM 7: **THE BEGINNING OF A GOURMET MEAL**
ITEM 8: **WHO'S EATING WHO?**

For more information contact David Steitz at (202)358-1730 or Allen Kenitzer at (301) 286-2806.

Video news file today at noon, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

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For Release
July 29, 1997

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RELEASE: 97-161

LAUNCH OF OCEAN-VIEWING SENSOR SET FOR AUGUST 1

The launch of the Sea-viewing Wide Field-of-View Sensor (SeaWiFS), onboard the Orbital Sciences Corporation (OSC), Dulles, VA, SeaStar spacecraft, is scheduled for Aug. 1, 1997, from Vandenberg Air Force Base, CA. The launch window opens at 4:17 p.m. EDT (1:17 p.m. PDT), with a ten-minute window available.

The SeaWiFS project is part of NASA's Mission to Planet Earth Enterprise, a long-term, coordinated research effort to study the Earth as a global system. Using the unique perspective available from space, NASA is observing, monitoring and assessing large-scale environmental processes, such as the oceans' productivity, focusing on climate change. In line with Mission to Planet Earth's commercial strategy, government-industry partnerships such as SeaStar provide NASA with needed data and may lead to practical commercial data use such as the development of fishing maps and estimation of crop yields for farmers and commodities markets.

"We're looking forward to this upcoming launch," said Dr. Mary Cleave, SeaWiFS Project Manager, at NASA's Goddard Space Flight Center, Greenbelt, MD. "The data from SeaWiFS will be of great benefit to our understanding of global carbon cycling."

Understanding the role of the oceans in the global carbon cycle -- the process by which carbon travels through the Earth's atmosphere, oceans, land and living organisms -- is essential to understanding climate change. Phytoplankton, microscopic marine plants, remove carbon dioxide from the atmosphere for internal use. Scientists are eager to understand this exchange of carbon dioxide and the role it plays in the global climate.

The SeaWiFS instrument will study the carbon cycle by observing the world's oceans from space and measuring "ocean color." The color of most of the world's oceans varies with the concentration of phytoplankton, which contain chlorophyll,

-more-

a green pigment. Near coastlines, the color of the ocean is affected by chlorophyll, dissolved organic material and suspended sediments from rivers and lagoons. By observing the color of different parts of the oceans, scientists can measure the amount of these materials in ocean water.

"A SeaWiFS launch at this time will be particularly important given what appears to be a very intense El Niño event developing in the equatorial Pacific Ocean," said Dr. Charles McClain, SeaWiFS Project Scientist, of Goddard. "SeaWiFS data will allow us to assess the global impact of the El Niño on marine ecosystems, including coastal waters off the U.S. West Coast."

SeaWiFS represents a new way of doing business for NASA. Rather than building, launching, and controlling a satellite to study an important aspect of the Earth's environment, NASA will purchase commercially available data from a privately built satellite and use the data for environmental research.

The SeaWiFS Team has developed, and will operate, a data system that will process, calibrate, validate, archive, and distribute SeaWiFS data for research. All other aspects of the mission -- satellite construction, launch, command and control and tracking -- are the responsibility of OSC. NASA has contracted with OSC to provide, for five years, the raw satellite data which will be used for research purposes. OSC will own the data rights for operational and commercial purposes.

OSC has integrated the SeaWiFS instrument, built by Hughes Electronics at the Santa Barbara Remote Sensing, Goleta, CA, into its SeaStar satellite and will market the data for commercial and operational use following launch.

SeaWiFS will be launched from a modified Lockheed L-1011 aircraft aboard an OSC Pegasus XL expendable launch vehicle. The Pegasus XL will be released from the L-1011 at an altitude of 39,000 feet over the Pacific Ocean. Following payload separation, an onboard hydrazine propulsion system will then raise the spacecraft to its final 440-mile (705-kilometer) circular orbit within approximately 20 days after launch.

SeaWiFS can view the world's oceans every two days. Since oceans cover 70 percent of the Earth's surface, SeaWiFS will provide information on a large part of the global biosphere. SeaWiFS also will provide important information for fisheries and coastal zone management. SeaWiFS data, which also are useful for viewing plants on land, can be combined with plant productivity data from other satellites, such as Landsat and other operational weather satellites, to measure the role of the biosphere in the total global carbon exchange.

NASA's Mission to Planet Earth Program Office, located at Goddard, manages the SeaWiFS contract and is developing and will operate the research data system for NASA's Office of Mission to Planet Earth, Washington, DC.

-end-

Video Advisory

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For Release
July 30, 1997

VIDEO ADVISORY: V97-71

HEADS-UP FOR SCHEDULED REPLAYS OF FOALE; WENDY LAWRENCE

Today's video feed will begin with replays of this morning's earlier events: an interview with Mike Foale and a Mir 24 crew press conference with Astronaut Wendy Lawrence. Also included is a replay of the arrival of the pressurized mating adapter (PMA-1) at the Kennedy Space Center. This adapter is a cone-shaped connector that will be attached to the Node-1, the space station's structural building block.

ITEM 1: INTERVIEW - DR. MICHAEL FOALE (REPLAY)

Foale talks with CBS reporter Bill Harwood in a pooled interview about life on Mir. The interview takes place at 8:45 -8:55 a.m. EDT and will be carried live on NTV.

ITEM 2: MIR 24 CREW PRESS BRIEFING WITH WENDY LAWRENCE (FIRST REPLAY SCHEDULED FOR 6 AM EDT)

This is a replay of a press conference scheduled to take place at 3 a.m. EDT from Moscow, Russia, and will not be broadcast live on NTV.
For more information contact Debra Rahn at (202) 358-1639.

ITEM 3: PMA-1 TO KSC (REPLAY)

This video shows the arrival activities of the pressurized mating adapter.
For more information contact Mike Braukus at (202) 358-1979.

ITEM 4-8: SEAWiFS PACKAGE (REPLAY)

For more information contact David Steitz at (202)358-1730 or Allen Kenitzer at (301) 286-2806.

Video news file today at noon, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

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For Release July 30, 1997

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RELEASE: 97-162

WORLD'S MOST POWERFUL TELESCOPES TEAM UP WITH A LENS IN NATURE TO DISCOVER FARTHEST GALAXY IN THE UNIVERSE

An international team of astronomers has discovered the most distant galaxy found in the universe to date, by combining the unique sharpness of the images from NASA's Hubble Space Telescope with the light-collecting power of the W. M. Keck Telescopes -- with an added boost from a gravitational lens in space.

The results show the young galaxy is as far as 13 billion light years from us, based on an estimated age for the universe of approximately 14 billion years. This would place the galaxy far back in time during the "formative years" of galaxy birth and evolution, less than a billion years after the birth of the universe in the Big Bang.

The detailed image shows that bright dense knots of massive stars power this object. Due to the firestorm of starbirth within it, the galaxy is intrinsically one of the brightest young galaxies in the universe, blazing with the brilliance of more than ten times our own Milky Way.

"We are fascinated to be witnessing the very early stages of the construction of what could well become a massive galaxy like our own Milky Way," says Garth Illingworth of the University of California, Santa Cruz. "This object is a pathfinder for deciphering what is happening in young galaxies, and offers a rare glimpse of the powerful events that transpired during the formation of galaxies."

- more -

"We were excited by the possibility that we may have found a unique example of a galaxy in formation at the time of the earliest quasars," said Marijn Franx of the University of Groningen in the Netherlands.

Predicted by Einstein's theory of general relativity, gravitational lenses are collections of matter (such as clusters of galaxies) that are so massive they warp space in their vicinity, allowing the light of even more-distant objects to curve around the central lens-mass and be seen from Earth as greatly magnified.

The object is so far away, observing it in such detail would tax the capabilities of both Hubble and Keck without the magnification of the gravitational lens, provided by a foreground cluster of galaxies that is much closer to us at five billion light-years.

Due to a rare and fortunate alignment of the young galaxy behind the foreground cluster, astronomers gain a magnified view that is five to ten times better than Hubble alone can yield for an object at such a great distance. A telltale sign of the lensing is the smearing of the remote galaxy's image into an arc-shape by the gravitational influence of the intervening galaxy cluster .

The smeared image of the galaxy stood out because of its unusual reddish color. "Such magnified galaxies had been observed before, but never with such a color. The special color of the galaxy in the arc is due to absorption by the matter in the universe between us and the galaxy, and suggested to us that it was at a great distance," says Franx.

The suspected remoteness of the lensed object was confirmed when the team of astronomers made spectroscopic observations with one of the twin 10-meter Keck telescopes on Mauna Kea, HI, to measure its redshift, and therefore its distance, based on the shifting of its light towards the red end of the visible light spectrum. The resulting high redshift corresponds to a very early era when the universe was just beginning to form galaxies.

Though candidates for still more distant objects have been proposed, they have not been confirmed spectroscopically. The previous most-distant known object was the quasar PC1247+34.

"Based on this image we can begin to make some conclusions about the early growth of galaxies," says Illingworth. "The knots show that starbirth happens in very tiny regions compared with the size of the final galaxy." This helps clarify the astronomer's view of the formation of galaxies as occurring within a cauldron of hot gas, with knots of intense star formation, strong winds, and "mergers" -- collisions of the dense star-forming knots.

Using Keck's spectroscopic capabilities, the astronomers have also, for the first time, been able to measure the motions of the gas within such a distant galaxy. The observations reveal gas flowing at nearly 500,000 miles per hour (200 km/sec), presumably accelerated by energy from supernova explosions going off like a string of firecrackers.

"The strong winds that we observe suggest that galaxies may lose a lot of material when they are young and thereby enrich the empty space around them," says Franx. "Many astronomers had speculated about the existence of such winds in such distant galaxies, and we now have an object where we can see them directly. It is striking that the most distant galaxy found to date is also the one that provides us the most detailed picture of events in such distant galaxies."

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc. (AURA) for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency (ESA). The W.M. Keck observatory is operated by the University of California, the California Institute of Technology and NASA.

- end -

EDITOR'S NOTE: Image files win GIF and JPEG format and captions may be accessed on the Internet via anonymous ftp from oposite.stsci.edu in /pubinfo

	GIF	JPEG
Gravitational Lens	gif/grlz492.gif	jpeg/grlz492.jpg

Higher resolution digital versions (300 dpi JPEG) of the release photograph are available in /pubinfo/hrtemp: 97-25.jpg (color) and 97-25bw.jpg (black and white).

GIF and JPEG images, captions and press release text are available via the World Wide Web at URL:

http://oposite.stsci.edu/pubinfo/PR/97/25.html and via links in
http://oposite.stsci.edu/pubinfo/Latest.html
http://oposite.stsci.edu/pubinfo/Pictures.html

News Release

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For Release
July 30, 1997

RELEASE: 97-163

NASA ANNOUNCES REVISED PLAN FOR MIR STAFFING

Astronaut Wendy Lawrence (Cmdr, USN) has been replaced by her backup, Dr. David Wolf, for the next long duration stay on the Russian Mir space station. The change will enable Wolf to act as a backup crew member for spacewalks planned over the next several months to repair the damaged Spektr module on the Russian outpost.

Lawrence does not fit in the Orlan suit which Russian cosmonauts use for spacewalk tasks and never underwent spacewalk training. Wolf fits in the Orlan suit.

Lawrence will continue training in the backup role according to normal procedures, in the unlikely event that she is needed.

To enable Wolf to complete spacewalk training at the Gagarin Cosmonaut Training Center outside Moscow, the launch of Atlantis on the next Shuttle-Mir docking mission, STS-86 in September, could be delayed approximately 10 days. Wolf had been scheduled for launch in January on STS-89 as the prime crew member for the final long duration increment on the Mir.

NASA will be conducting their normal safety reviews in preparation for the transfer of a U.S. astronaut to Mir as was done before the last shuttle docking mission. This review will imclude an evaluation of all the events that have occurred aboard the Mir since the last docking mission. That final determination is expected at the conclusion of the formal U.S. review process at the shuttle program Flight Readiness Review in September.

NASA and Russian space officials have discussed a variety of options for backup spacewalk capability since the Spektr module was damaged in the collision of a Progress

- more -

resupply craft on June 25. It was jointly agreed by both sides that it would be mutually beneficial to have all three crew members on the Mir qualified for spacewalks in the event additional assistance is needed from the U.S. astronaut on the station.

"The Russians usually only fly two people trained for spacewalks," said Frank Culbertson, Manager of the Shuttle-Mir Phase One program. "Because of the number and the nature of spacewalks under consideration by the Russians to repair the Spektr, we have discussed at length the advantage of having another astronaut qualified for those tasks."

Culbertson added, "The fact that Wendy does not fit in an Orlan suit is not unusual. When first selected to fly on the Mir, it was absolutely normal that she would not be considered to be a spacewalk qualified crew member. Only because of subsequent events have requirements on board the Mir changed. As a result, the joint decision was made to have all three crew members on board qualified to handle spacewalking tasks."

Lawrence was informed of the decision by Culbertson, who is in Russia for meetings with Russian space officials.

Because of her knowledge and experience with Mir systems and with crew transfer logistics for the Mir, NASA will fly Lawrence on STS-86 in September which will deliver Wolf to the Russian station. Wolf is fully trained on both Mir and Soyuz capsule systems.

- end -

Video Advisory

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For Release
July 31, 1997

VIDEO ADVISORY: V97-72

SOHO: LET THE SUN SHINE IN

Today's video feed includes recent images taken by NASA and the European Space Agency's Solar and Heliospheric Observatory (SOHO) that shows the dynamic surface of the Sun.

ITEM 1: ANIMATION - SOHO SPACECRAFT
ITEM 1a: A MONTH IN THE LIFE OF THE SUN

These images were recorded with SOHO's Extreme Ultraviolet Imaging Telescope during the month of May, 1997, at a rate of one frame every 17 minutes. This is the first time a complete 28-day rotation of the Sun has been observed with this resolution.

ITEM 1b: SOLAR HICCUP

This sequence was taken April 7, 1997, showing the coronal mass ejections leaving the Sun. One ejection is like a balloon expanding from the center of the Sun.

ITEM 1c: SOHO CHRISTMAS MOVIE

This series of images, taken December 22-27, 1996, show the Sun drifting in front of the Milky Way constellation, Sagittarius.

ITEM 1d: SOHO MISSION OPERATIONS

This footage is of scientists in the SOHO mission operations room.

ITEM 1e: SOHO OPERATIONS CENTER

In this video, scientists are at work with images from SOHO.
For more information contact Wade Sisler at (301)286-6256.

Video news file today at noon, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

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For Release

August 1, 1997

RELEASE: 97-164

NASA AND FAA ANNOUNCE AVIATION DESIGN COMPETITION WINNERS

Winners of the 1997 National General Aviation Design Competition were named by NASA and the Federal Aviation Administration today. The competition, which is in its third year, allows university students to participate in a major national effort to rebuild the U.S. general aviation sector.

NASA Administrator Daniel S. Goldin and FAA Acting Administrator Barry Valentine presented the awards in a ceremony at the Experimental Aircraft Association's Annual Convention and Fly-In at Oshkosh, WI.

For the purpose of the contest, general aviation aircraft are defined as single-pilot, fixed-wing, single-engine, propeller-driven aircraft for two to six passengers. Teams of undergraduate and graduate students from U.S. engineering schools work with faculty advisors to address design challenges for a small aircraft transportation system. The competition seeks to raise student awareness of the value of general aviation for business and personal use, while promoting an understanding of its economic relevance. NASA and the FAA believe that this kind of competition serves to stimulate breakthroughs in technology and their application in the general aviation market.

-more-

The national goal for revitalizing the industry presents excellent, open-ended design challenges that stimulate engineering students and provide the basis for a quality, real-world educational experience. Teams were asked to address design challenges in one or more of the following technical areas: Integrated cockpit systems; propulsion; noise and emissions; integrated design and manufacturing; aerodynamics; operating infrastructure; and new designs such as air-cars.

Students may consider designs for an entire aircraft or for a system or subsystem. The first place award was presented to a student team from the University of Kansas, Wichita State University, and Kansas State University. The team's design offers a four-passenger, kit plane "for the pilot with limited resources." The design claims payload, range, cruise velocity, take-off and landing field lengths, rate of climb, and handling qualities comparable to a Cessna 172R for about half the cost, or $75,000.

The team calls its aircraft "Adagio" in honor of its potential for graceful flight reminiscent of the adagio musical movement of a symphony. The design uses a Zoche AeroDiesel Engine Z0 02A and features an unusual, inverted "V" tail. The team believes that its design can be built in about 200 hours, a fraction of the time required for current kit planes. The short assembly time for the Adagio is due to use of pre-assembled/pre-fabricated structures. This approach would require a new interpretation of FAA's rule which requires an owner to build and/or fabricate at least 50 percent of a kit-type plane.

This is the second time the Kansas team has garnered the first place award in this prestigious and highly competitive competiton. As the first place winner, design team members will share a cash award of $3,000 while the participating unversity departments will share a $5,000 cash award.

The second place award was presented to students from the Department of Aerospace Engineering at Pennsylvania State University, University Park. The design, dubbed "The Stingray," won praise from the review panel as a well-engineered aircraft design with realistic costing. The panel cited the team for excellent targeting of general aviation revitalization goals. The design features a high-performance aircraft, with a high-power, turbocharged engine and retractable landing gear. A low-wing, pusher configuration is used, with advanced composite materials offering lighter-weight and improved aerodynamic efficiency. Crashworthiness, good stall characteristics, structural simplification for ease of manufacturing, and a user-friendly, multifunctional-display cockpit were also hallmarks of the award-winning design. As the second place winner, team members will share a cash award of $2,000.

The third place award was presented to a student design team from the Virginia Polytechnic Institute, Blacksburg. The team will share a $1,000 cash award. This design is for a sport utility aircraft named the "VenTure." A single-engine, propeller diver, fixed-wing amphibious aircraft, the VenTure can take-off and land on water and then taxi onto land, or land on standard runways through the use of a hydraulic retraction landing gear system. The energy-efficient and environmentally friendly aircraft uses a powerful and light Aero-Diesel engine with record low emission levels. The aircraft incorporates many design elements that enhance safety and add passenger comfort.

-more-

A special award for Greatest Retrofit Potential was given to Jennifer Wilson, a Princeton University student. The award was given because Wilson's design offered the greatest potential for being retrofitted in currently operating general aviation aircraft. Wilson, a senior and May graduate majoring in Mechanical and Aerospace Engineering, received the $500 award, which is sponsored by the Aircraft Owners and Pilots Association Air Safety Foundation. Wilson's design presents innovative ideas for simplication of cockpit instrumentation through the inclusion of a head-up display as an approach to reducing pilot error.

The intuitive display drew praise from the competition's expert review panel for its simplicity and uncluttered presentation of information using symbols that have universal appeal, cross language barriers and minimize the use of numerical data. Simple and effective visuals provide critical take-off and landing data, situational awareness, engine/fuel information, altitude data and stall warnings.

Wilson's award is unique in that it is the first in the competition ever given to a design submission by an individual. All previous awards in the prestigious and highly competitive competition have gone to student teams.

The National General Aviation Design Competition is coordinated for NASA and the FAA by the Virginia Space Grant Consortium. Guidelines for the fourth annual competition, to be held during the 1997-1998 academic year, will be available from the Consortium in August by calling 757/865-0726 or by E-mail message to: msandy@pen.k12.va.us.

-end-

News Release

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For Release
August 1, 1997

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RELEASE: 97-165

REVOLUTIONARY NEW AIRCRAFT MAKES DEBUT AT OSHKOSH AIRSHOW

NASA Administrator Daniel S. Goldin today joined Williams International Chairman Dr. Sam Williams at Oshkosh, WI, in the debut of the V-JET II, an all-composite, turbofan-powered light aircraft designed for future flight testing of modern turbofan engines. Goldin and Williams were attending the annual Experimental Aircraft Association (EAA) Fly-In and Convention being held this week at Oshkosh, where the V-JET II is being demonstrated.

"The V-JET II marks a turning point in general aviation," said Goldin. "U.S. companies can only regain a leadership position in general aviation by developing aircraft that combine innovative designs with cutting-edge, revolutionary technologies that ensure pilot and passenger safety and increase aircraft performance at affordable costs."

Dr. Williams added, "Our objectives are to develop the quietest and least polluting propulsion system in aviation as well as the lightest weight turbine propulsion system for manned aircraft. We also expect to be able to price these engines low enough to stimulate the rapid expansion of the light aircraft industry in the United States."

Provided by Williams for use in the Agency's General Aviation Propulsion (GAP) program, the aircraft will flight-demonstrate breakthrough, low-cost turbine-engine propulsion systems for light, general aviation aircraft with cruising airspeeds greater than 200 knots.

The V-JET II, built by Scaled Composites, Mojave, CA, was designed by Williams International, Walled Lake, MI, to demonstrate its new FJX-2 turbofan engine which it is developing under a GAP Cooperative Agreement. The aircraft will be used to demonstrate the new FJX-2 turbofan engines over a range of flight speeds and altitudes that are expected to be required in future turbofan-powered light aircraft.

-more-

"With the new engines being developed in the GAP program, general aviation will take a significant leap forward," said Leo Burkardt, GAP program manager at NASA Lewis Research Center, Cleveland, OH. "The V-JET II gives us a glimpse at the exciting revolution in light aircraft that the GAP engines will make possible.

The aircraft currently is being powered by two existing low bypass ratio, 550 lb. thrust FJX-1 turbofan engines, developed earlier by Williams International. These interim engines will be used to evaluate the aircraft's performance and systems prior to installation of the FJX-2 engines. Flight tests of the FJX-2 engines will occur by the year 2000.

NASA's GAP program is aimed at revitalizing general aviation by uniting propulsion and airframe manufactures, and other industries with government to develop and demonstrate new general aviation propulsion systems. Future aircraft will utilize commercial versions of these revolutionary engines that will make future light aircraft safer, smoother, quieter and more affordable.

- end -

News Release

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For Release

August 2, 1997

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RELEASE: 97-166

LIGHT PLANE TECHNOLOGIES ADVANCE ON BROAD FRONT

Three years after the government and the U.S. light plane industry made a pact to revitalize general aviation in this country, leaders of the Advanced General Aviation Transport Experiment (AGATE) Alliance are reporting impressive progress. AGATE partners are working to make airplanes as easy to operate as cars.

"These advances were made possible by investments in new technologies for general aviation and by investments in technologies for air traffic modernization and aviation safety, from which General Aviation will greatly benefit" said Dr. Robert Whitehead, NASA's associate administrator for aeronautics.

"These technology programs will enable the realization of NASA's vision for a small aircraft transportation system that brings safe, affordable and convenient personal air transportation to far more of America's population," he added.

Whitehead's comments were made at a joint NASA, Federal Aviation Administration (FAA) and U.S. industry news briefing held today at the Experimental Aircraft Association annual Fly-In and Convention, Oshkosh, WI. Other briefing participants included Guy Gardner, FAA associate administrator for regulation and certification.

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The following AGATE program highlights were addressed:

AGATE FORMS PILOT TRAINING CURRICULUM DEVELOPMENT TEAM

The Federal Aviation Administration has selected a team led by Embry Riddle Aeronautical University to develop a revolutionary training curriculum that could cut the cost of obtaining an instrument rating for non-pilots by as much as 25 percent. The team will also develop learning modules for glass cockpit multi-function displays and single-lever power control systems.

In the next few years, these products will be integrated into training methods for the complete AGATE glass cockpit.

Project cost will be evenly split between government and industry. NASA is funding the government's $1.5 million share the first year, while the FAA plans to fund the government's share the remaining years of the effort.

Team members include Advanced Creations, Inc., Dayton, OH; Cessna Aircraft Company, Wichita, KS; Florida Institute of Technology, Melbourne, FL; Jeppesen Sanderson, Englewood, CO; and Raytheon Aircraft, KS. Agreements are being negotiated with other potential members.

SINGLE LEVER POWER CONTROL DEMONSTRATED IN FLIGHT

Single lever power control works much like the accelerator pedal in an automobile, by taking the complex system of control levers and gauges and replacing them with a single lever and single display.

The first successfully flown electronic single lever power control for air-cooled engines was onboard Aurora Flight Sciences' modified Cessna 02-A. Aurora's device took the three standard engine control levers -- throttle, fuel-air mixture and propeller pitch angle -- and had them performed by a computer referred to as a single channel full authority digital engine control.

Aurora Flight Sciences, Manassas, VA, developed its power controller under NASA's Small Business Innovation Research Program. NASA's Lewis Research Center, Cleveland, OH, is managing the effort to develop guidelines, standards and certification methods for engine controls and diagnostics.

Cessna Aircraft will soon be flight testing their modified Cessna 182 RG with a mechanical single lever power control connecting the throttle with the propeller. A dual channel engine control is used to control the electronic ignition and fuel injection. This technology is being developed by the ten industry members of the Propulsion Sensors and Controls Work Package of AGATE.

Advantages of single lever power control systems include increased engine performance and fuel efficiency while substantially reducing pilot workload.

ALL OCCUPANTS SURVIVE CRASH TEST

A NASA Small Business Innovation Research Program contractor successfully crash-tested a small airplane designed to protect occupants against fatal injuries using airbags and energy-absorbing composite structures.

Terry Engineering, Wichita, KS -- along with Cirrus Design Corp., Duluth, MN, and NASA's Langley Research Center, Hampton, VA -- has crash-tested a total of four airplanes over a two-year period. The tests typically took place at about 60 mph impact speed into both earth and hard surfaces. The tests also successfully demonstrated an improved shoulder harness system and energy-absorbing seats.

The goal of the program was to apply the techniques, which have been successfully applied in military helicopters, race cars and modern automobiles, to improve the survivability in crashes of small composite airplanes. A further goal was to reduce injury severity in survivable crashes.

The program used a combination of analysis, subscale quasi-static testing and full scale crash testing to achieve these goals. In the final crash test, all of the crash dummies on board "survived" the crash, a first for general aviation crash tests.

NON-PROFIT CORPORATION FORMED TO HANDLE AGATE BUSINESS

John F. Sheehan, President of Business Development Systems, Inc., has been named as executive director of the newly established AGATE Alliance Association, Inc. (AAAI).

AAAI is a non-profit organization, established by the industry members of the AGATE Alliance as a means for conducting administrative and managerial business. The organization was created by the AGATE Executive Council and located in Hampton, VA, to provide the AGATE Alliance with greater flexibility. AAAI also maintains the AGATE website at URL:

http://agate.larc.nasa.gov

AFFORDABLE DATALINK RADIO DEMONSTRATED

An AGATE Alliance member company has successfully demonstrated a digital datalink radio using affordable technologies for retrofit as well as future general aviation aircraft.

The high bandwidth software-based digital radio, developed by NavRadio Corp., Denver, CO, has the potential for quickly communicating weather, clearance, flight planning, maintenance and other data. It has enough capacity to bring national and regional aviation weather graphics into the cockpit of general aviation airplanes for display on computer screens. Datalink radios may help to reduce weather-related general aviation accidents, the leading cause of light plane fatalities today.

Datalink radio technology is expected to be available commercially within the next 24 months. The technology is expected to play a key role in enabling the FAA's "free flight" concept for greater flexibility in user-preferred flight routings.

NEW PROPELLER INNOVATION IS QUIET, LIGHT AND EFFICIENT

A propeller made of space-age composite materials is being hailed as the first major improvement in fixed-pitch propellers for light planes since the 1930's. The propeller, an advanced "quasi-constant speed" propeller, permits a fixed-pitch propeller to perform like a variable-pitch propeller but without the complexity of a variable-pitch propeller.

As part of its work in the AGATE Integrated Design & Manufacturing Work Package, Global Aircraft, Starkville, MS, took advantage of modern aerodynamic technology and advanced composite structural processes to design and develop a composite quasi-constant speed propeller suitable for a typical 150-180 horsepower general aviation engine.

The propeller will automatically change pitch by flexure of the propeller blade rather than mechanical rotation of the blade shank. This technology makes it possible to develop a propeller that is both more efficient and quieter than current metal propellers.

Production of the propeller is anticipated to begin in September.

-end-

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For Release

August 4, 1997

RELEASE: 97-168

NASA SELECTS ISO 9001 REGISTRAR

NASA has selected a third-party registrar, Det Norske Veritas Certification, Inc (DNV Inc.) located in Houston, TX, to provide detailed compliance audits of NASA's Ames Research Center, Dryden Flight Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Kennedy Space Center, Langley Research Center, Lewis Research Center, Stennis Space Center and NASA Headquarters.

This selection is a key milestone in moving towards NASA Administrator Daniel S. Goldin's challenge to have the Agency ISO 9001-certified by September 1999.

ISO 9001, "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing," is an international standard for quality management systems that has been accepted by over 100 countries around the world. NASA is the first federal agency to commit to ISO 9001 certification. Once certified, NASA will demonstrate its commitment to excellence in aeronautics and spaceflight technology, as well as in internationally accepted quality management practices.

The standard suggests 20 basic elements as the essential building blocks for an effective management system. The standard offers great flexibility in applying the 20 elements, thereby promoting streamlined, effective and innovative management processes. The system uses a third-party certification process to ensure that NASA meets national accreditation standards.

-more-

The primary thrust of the standard is to promote national and international competitiveness for suppliers through application of validated quality management systems. Certification to ISO 9001 by a third-party registrar validates that the new practices are in place and working.

The performance-based fixed-price consolidated contract to DNV Inc. is for $513,350 for instant action, with a total potential value of the contract with indefinite quantity items at $1,143,050. Contract oversight will be managed by NASA's Lewis Research Center in Cleveland, OH.

-end-

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For Release
August 5, 1997

RELEASE: 97-170

REMOTE CONTROL ROBOT BREAKS ROUGH TERRAIN TRAVEL RECORD, PAVES PATH FOR FUTURE PLANETARY SCIENCE MISSIONS

A hardy traveler named "Nomad" recently set a record by traveling farther than any remotely controlled robot has before over rough territory. The robot's four wheels logged more than 133 miles (215 kilometers) across Chile's rugged Atacama Desert from June 15 to July 31, during a field experiment designed to prepare for future missions to Antarctica, the Moon and Mars.

Scientists from NASA's Ames Research Center, Moffett Field, CA, and Carnegie Mellon University's Robotics Institute in Pittsburgh performed experiments with Nomad for 45 days, conducting both technology demonstrations and scientific activities. Nomad often worked on its own to avoid obstacles and, in a clear foreshadowing of the future duties of similar robots, it recognized meteorites planted in the desert as a test and may even have found a fossil.

"The Atacama trek is a quantum leap for the planetary robotics culture, where the historical standard of travel has been yards, not miles," said principal investigator Dr. William L. "Red" Whittaker of Carnegie Mellon. "Although the 'straight-line' distance on a map was only about 13 miles, Nomad had to weave through very difficult terrain, and it made numerous sidetrips for science and to test the meteorite sensors. It is a pioneer laying a trail toward future planetary robots, who will be challenged for thousands of miles and years of operations, in bold missions like searching for signs of life."

-more-

The 1,600-pound robot, developed at Carnegie Mellon and funded by NASA, validated the use of color stereo video cameras with human-eye resolution for geology. A separate panospheric camera returned more than a million video panoramas from the Atacama, a cold, arid region located above 7,000 feet.

"During different phases of testing, we configured the robot to simulate wide-area exploration of the Moon, the search for past life on Mars and for the gathering of meteorite samples in the Antarctic," said Dave Lavery, telerobotics program manager at NASA Headquarters, Washington, DC. "Nomad met or exceeded all of our objectives for this project."

"We want to give planetary scientists experience using mobile robots, so that they can develop the skills necessary for performing remotely guided investigations," added Dr. David Wettergreen, Nomad project leader at Ames.

Nomad is about the size of a small car. To maneuver through rough terrain, the robot has four-wheel drive and four-wheel steering with a chassis that expands to improve stability and travel over various terrain conditions. Four aluminum wheels with cleats provide traction in soft sand. For this terrestrial experiment, power was supplied by a gasoline generator that enabled the robot to travel at speeds up to about one mile per hour.

"Nomad drove itself through about 12 miles (20 kilometers) of the 133 miles it traveled," said Dr. Mark Maimone, Nomad software and navigation lead at Carnegie Mellon. "Autonomous driving is critical for planetary exploration because the communications delay between Earth and planets can be many minutes. With autonomous driving, a robot can explore a much greater distance because it doesn't have to wait for a person to decide a safe route. The rover is able to see obstacles and recognize them on its own," he said.

Nomad's unique onboard panospheric camera provided live 360-degree, video-based still images of the robot's surroundings. "Experimentation with the panospheric camera validated the use of immersive imagery for remote driving," Maimone said.

The camera takes a 360-degree picture -- one frame per second -- and did so throughout the mission. The high-resolution video camera focuses up into a hemispheric mirror similar to a store security mirror. The video view includes all of the ground up to the horizon in the circle surrounding Nomad.

"The camera is a new technology, and it gave members of the public as well as scientists a new way to drive with peripheral, or side vision," he explained. "We sent the Nomad pictures to a theater at the Carnegie Science Center in Pittsburgh that has a 200-degree, semi-circular screen. Fifty people at a time pushed a button to vote on whether the robot should look to the left, center or right."

On June 25, NASA scientists were driving the robot remotely from their laboratory at Ames, more than 5,455 miles (8,780 kilometers) away, when the scientists in California found a rock that appeared to contain algae fossils.

Using the rover's cameras, scientists noticed a light-colored, three-inch diameter rock with a darker, intricately shaped marking in a rock outcrop in the Chilean desert. The rock was retrieved by Chilean scientists and was brought to Ames for scientific analysis.

"The rock is sedimentary and was formed in an ancient sea bed. However, the consensus is that this rock does not contain fossilized algae," said Dr. Nathalie Cabrol, the expedition's NASA science team leader. The science team was excited to learn that the outcrop was an undiscovered geologic deposit from the Jurassic Period.

"This experience is one of the most important of the science tests," Cabrol said. "I am not sure that we can get much closer to what may happen with the research of interesting rocks on Mars and the related search for life in the coming Mars exploration program. We are most likely to face this exact situation of selecting a rock because it looks interesting to us. Once in the lab, we were unable to tell conclusively if there had been life in the rock at one time or not."

"The first-level interpretation from the rover camera was close enough, fossil or not," she added. "The team was able to reconstruct the geology of the site, often matching or at least getting very close to the conclusions of the back-up field team."

The total cost of developing Nomad and conducting the desert trek is $1.6 million. The project is funded by NASA with in-kind support from corporate sponsors and educational foundations.

NASA and Carnegie Mellon are formulating plans to use Nomad to look for meteorites in Antarctica in 1998 and 1999.

Further information about the Atacama desert trek, images and data are available from the Ames Intelligent Mechanisms Group at URL:

http://img.arc.nasa.gov/Nomad

Carnegie Mellon's Robotic's Institute also has a website at URL:

http://www.ri.cmu.edu/atacama-trek

-end-

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For Release

August 6, 1997

RELEASE: 97-171

HUBBLE SEPARATES STARS IN THE MIRA BINARY SYSTEM

Although the giant star Mira has been known for 400 years, astronomers have had to wait for NASA's Hubble Space Telescope to provide the first ultraviolet images of the extended atmosphere of the cool red giant star and its nearby hot companion.

By giving astronomers a clear view of the individual members of this system, Hubble has provided valuable insights into other types of double star systems where the stars are so close they interact with one another.

The separation between Mira and its companion is about 70 times more than that between Earth and the Sun, (equal to an angular size of only 0.6 arcseconds -- the apparent diameter of a dime at four miles away) even smaller than the typically fuzzy ground-based telescopic image of a single star as smeared out by Earth's turbulent atmosphere.

Using the European Space Agency's Faint Object Camera aboard Hubble, Margarita Karovska and John Raymond of the Harvard-Smithsonian Center for Astrophysics, Cambridge, MA; Warren Hack of the Space Telescope Science Institute, Baltimore, MD; and Edward Guinan of Villanova University, Villanova, PA, obtained both ultraviolet and visible light images and spectra of the two separate stars in the Mira system. The results appear in the June 20 Astrophysical Journal Letters.

-more-

In ultraviolet light, Hubble has resolved a small hook-like appendage extending from Mira in the direction of the companion, which might be material from Mira being gravitationally drawn toward the smaller star. Alternately, it could be material in Mira's upper atmosphere being heated due to the companion's presence.

Hubble's visible-light images show that Mira has an odd, asymmetrical shape resembling a football. This may be tied to dramatic changes occurring during its expansion-contraction cycles, or to the presence of unresolved spots on its surface. Hubble allows astronomers to measure the star's size at about 60 milliarcseconds, corresponding to a diameter some 700 times larger than our Sun. If Mira were at the center of our solar system, it would extend out more than 300 million miles, well beyond Mars' orbit and nearly two-thirds of the way to Jupiter.

Mira (officially called Omicron Ceti in the constellation Cetus) is the prototype for an entire class of stars known as "Mira-type variables." Although once like our Sun, Mira is now at the end of its life, and has evolved into a cool red giant star that is highly variable in brightness. Contracting and expanding every 332 days, Mira sheds vast amounts of material through its powerful "wind" of gas and dust.

Mira's companion is a burned-out star called a white dwarf that is surrounded by material captured from Mira's wind. At a distance of about 400 light-years, Mira is the closest wind-accreting binary system to Earth.

Separating the spectra of Mira and its companion -- something astronomers previously have tried to do through indirect means -- is a crucial step for studies of physical processes associated with wind accretion in binaries.

Mira was discovered on August 13, 1596, by Dutch astronomer David Fabricus, who mistook it for a nova because it later faded from view. He called it Mira, meaning "The Wonderful." Astronomers later realized it was really the first case of a variable star.

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc., for NASA, under contract with NASA's Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency.

EDITORS NOTE: The Hubble images of Mira are available to media representatives by calling the Imaging Branch at NASA Headquarters at 202/358-1900. Photo number is: (color) 97-HC-537.

Image files in GIF and JPEG format and captions may be accessed on the Internet via anonymous ftp from oposite.stsci.edu in /pubinfo.

	GIF	JPEG
PRC97-26 Mira	gif/mira.gif	jpeg/mira.jpg

Higher resolution digital versions (300 dpi JPEG) of the release photograph are available in /pubinfo/hrtemp: 97-26.jpg (color) and 97-26bw.jpg (black & white).

GIF and JPEG images, captions and press release text are available via the World Wide Web at URL:

http://oposite.stsci.edu/pubinfo/PR/97/26.html and via links in
http://oposite.stsci.edu/pubinfo/Latest.html or
http://oposite.stsci.edu/pubinfo/Pictures.html

-end-

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For Release

August 6, 1997

RELEASE: 97-172

LEWIS SATELLITE READY TO DEMONSTRATE FINER SPECTRUM OF EARTH VIEWS

Outfitted with advanced technology Earth-imaging instruments and subsystems intended to push the state-of-the-art in scientific and commercial remote sensing, NASA's Lewis satellite is scheduled for launch at 2:51 a.m. EDT on August 10 from Vandenberg Air Force Base, CA.

One of several focused, small satellite missions under development by NASA's Mission to Planet Earth enterprise, Lewis features remote-sensing instruments designed to split up the spectrum of light energy reflected by Earth's land surfaces into as many as 384 distinct bands. In addition, Lewis carries the Ultraviolet Cosmic Background astrophysics instrument built by the University of California at Berkeley. The satellite was built by TRW Space & Electronics Group, Redondo Beach, CA, for launch aboard a Lockheed Martin Launch Vehicle, under NASA's Small Spacecraft Technology Initiative.

"Lewis has proven to be an invaluable groundbreaker in our efforts to infuse fast-track procurement methods and industry-driven technology development into all of NASA's future spacecraft," said Samuel Venneri, Chief Technologist at NASA Headquarters in Washington. "This philosophy has since helped spawn the Agency's New Millennium program and, more importantly, has fostered a mindset of innovation and partnership with industry across all of NASA's technology field centers."

-more-

The primary payload on Lewis consists of two complementary hyperspectral imaging radiometers. The 384-band Hyperspectral Imager instrument built by TRW covers the spectral range from .4 microns to 2.5 microns. It is based on a conventional airborne spectro-radiometer design integrated with new advanced technology components, making it the first high-resolution hyperspectral imager to be flown in space. The Hyperspectral Imager can resolve objects on the ground as small as 16 feet (five meters) in its panchromatic band and 100 feet (30 meters) in its hyperspectral bands.

The companion hyperspectral instrument on Lewis is called the Linear Etalon Imaging Spectral Array. Built by NASA's Goddard Space Flight Center, Greenbelt, MD, it can "see" the Earth in 256 bands with 1,000-foot (300-meter) resolution, in the spectral region from 1.0 to 2.5 microns. The Array's fundamentally new technology provides data in the same spectral bands as the Hyperspectral Imager while offering "factors-of-ten" reductions in size, cost and design complexity.

The Hyperspectral Imager and the Linear Etalon Imaging Spectral Array accomplish theoretically equivalent measurements using different approaches. The Imager takes a snapshot of a narrow "one-dimensional" stripe of the Earth and separates the incoming optical signal into its component spectral bands for a concurrent spectral observation. It then uses the motion of the spacecraft over its ground track to build up the spatial image through successive snapshots. Conversely, the new approach enabled by the Array technology involves a "two-dimensional" snapshot of 256 adjacent stripes of the image, with each stripe viewed in a different spectral band. Using the motion of the spacecraft over the ground track, the Linear Etalon Imaging Spectral Array then takes 256 successive snapshots, thus building up the complete spectral signature of each of the image stripes.

As a comparison, the primary imager on the current Landsat remote-sensing satellites views the Earth in just seven spectral bands with about ten times lower resolution (although it has some thermal band capabilities beyond those of the Hyperspectral Imager's image collection system). A key area of potential scientific and commercial interest in Lewis is the idea of "data fusion," in which the unique new capabilities of Lewis are merged with the more mature Landsat data products to provide new insights.

"The sensors on Lewis will allow environmental scientists to discriminate between different types of vegetation, and determine their health, with a fine precision only hinted at by previous space- and aircraft-based measurements," said Dr. Diane Wickland, program scientist in NASA's Office of Mission to Planet Earth. "It also will enable much more accurate estimates of the run-off from spring snow melts, the distribution of surface minerals, and the composition of sedimentary discharges into coastal waters."

Potential commercial applications include pollutant monitoring, analysis of endangered species habitats, estimation of forest and agricultural productivity, soil resources and crop residue mapping and assessments of environmental impacts from energy pipelines, Wickland said.

-more-

NASA's Stennis Space Center, Stennis, MS, will be the Agency's focal point for commercial applications and technical support on Lewis, and will help distribute its data. Stennis also will work with TRW on spreading the results of Lewis into secondary school classrooms and will support validation of Lewis data via an aircraft-borne hyperspectral instrument flown on a NASA Learjet.

Another airborne imaging spectrometer instrument operated by NASA's Jet Propulsion Laboratory, Pasadena, CA, will support calibration and validation of measurements from Lewis and will help determine how the signals are changed when they pass through Earth's atmosphere.

Named for the 19th century U.S. explorer Meriwether Lewis, the mission incorporates approximately 40 new technologies and state-of-the-art components. Technologies developed by Goddard include miniaturized cryocoolers, new composite material structural components with an integrated thermal and structural design, faster data processors, lightweight propellant tanks, miniaturized star trackers, and exploitation of the Global Positioning System for space timekeeping, navigation and attitude control.

Lewis technologies contributed by NASA's Langley Research Center, Hampton, VA, include a Recorder Interface Module that provides both primary and back-up interfaces between the Lewis data recording system, the science instruments, the on-board computer and the communication subsystem. The Lewis Enhanced Attitude Control Experiment should lead to better future spacecraft attitude control systems that take into account the many disturbances a spacecraft experiences while in orbit, ensuring its science instruments remain accurately pointed. The Cloud and Feature Editing Experiment will assist the Hyperspectral Imager by picking out areas of the Earth's surface that are covered by clouds, ensuring that only unobscured images of the Earth's surface are stored and transmitted to the ground for later analysis, doubling the useful capacity of the Hyperspectral Imager's image collection system.

The total cost to NASA of the Lewis mission, including its launch vehicle and one year of orbital operations, is $64.8 million. NASA incurred an additional cost of $6.2 million for storage and maintenance of the spacecraft during a one-year delay due to launch vehicle issues. Lewis and its partner remote-sensing technology demonstration mission Clark were selected by NASA for development in June 1994. The development of Clark has been paced by difficulties in readying some of its complex new technologies for flight, including its commercially provided high-resolution imager. Clark is scheduled for launch in 1998.

Under the direction of TRW and Lockheed Martin, an LMLV-1 booster will launch Lewis from Space Launch Complex 6 at Vandenberg. All checkout and launch-control equipment is housed in a Launch Vehicle Control Van, a 40-foot vehicle located near Launch Complex 6.

Further technical details on the Lewis spacecraft and some color image files of the spacecraft being prepared for launch are available on the Internet at the following URL:

http://www.trw.com/seg/sats/SSTI.html

Lewis is part of NASA's Mission to Planet Earth enterprise, a long-term research program designed to study the Earth's land, oceans, air and life as a total system.

-end-

News Release

National Aeronautics and
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For Release

August 7, 1997

RELEASE: 97-173

**COUNTDOWN TEST REVEALS FUEL LEAKS
ON CASSINI MISSION CENTAUR UPPER STAGE**

During the Tuesday, August 5, terminal countdown demonstration test, Air Force and Lockheed Martin engineers observed leakage in the Centaur stage of the Titan IV-B rocket for the Cassini mission to Saturn. This test, in which the Centaur is fully fueled, is normally conducted to identify problems which could affect the performance of the Titan IV. Leakage of this nature can occur on occasion when the Centaur is first tanked with cryogenic propellants. During this test, engineers observed some liquid hydrogen and liquid oxygen leakage in the thrust section.

Engineering assessments are currently being performed to determine the cause of the leakage and what corrective action is necessary to ready the vehicle for the Cassini launch. Until this has been done, what impact this might have on the planned October 6 launch date, if any, cannot be definitely determined. A repeat test will be performed to assure that there are no additional leaks or other issues.

-end-

News Release

National Aeronautics and
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For Release

August 8, 1997

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RELEASE: 97-174

MARS PATHFINDER RESULTS GENERATING NEW PICTURE OF MARS AS MISSION MOVES INTO EXTENDED OPERATIONS

NASA's Mars Pathfinder spacecraft -- a novel mission to send an inexpensive lander and roving prospector to the surface of Mars -- has concluded its primary mission, fulfilling all of its objectives and returning a wealth of new information about the red planet.

The robotic lander, which continues to explore an ancient outflow channel in Mars' northern hemisphere, completed its milestone 30-day mission on Aug. 3, capturing far more data on the atmosphere, weather and geology of Mars than scientists had expected. In all, Pathfinder has returned 1.2 gigabits (1.2 billion bits) of data and 9,669 tantalizing pictures of the Martian landscape to date.

"The data returned by the Sagan Memorial Station and Sojourner has been nothing short of spectacular, and it will help provide a scientific basis for future Mars missions, including a sample return, for years to come," said Dr. Wesley Huntress, NASA associate administrator for space science. "The Pathfinder team's "can do" attitude not only was critical to overcoming several complex technical challenges during development and cruise, but has carried through the uncharted territory of operating a solar-powered lander and mobile rover on the surface of a planet millions of miles from Earth."

"This mission demonstrated a reliable and low-cost system for placing science payloads on the surface of Mars," said Brian Muirhead, Mars Pathfinder project manager at NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA. "We've validated NASA's commitment to low-cost planetary exploration, shown the usefulness of sending microrovers to explore Mars, and obtained significant science data."

-more-

A new portrait of the Martian environment has begun to emerge in the 30 days since Pathfinder and its small, 23-pound rover began to record weather patterns, atmospheric opacity and the chemical composition of rocks washed down into the Ares Vallis flood plain. The rover's alpha proton X-ray spectrometer team, led by principal investigator Dr. Rudolph Rieder, has been able to analyze the first-ever in-situ measurements of Mars rocks.

"We are seeing much more differentiation of volcanic materials than we expected to see," said Dr. Matthew Golombek, Mars Pathfinder project scientist at JPL. "The high silica content of one of the rocks we've measured, nicknamed Barnacle Bill, suggests that there was more crustal activity -- heating and recycling of materials -- early in Mars' history than we thought."

Similarly, atmospheric-surface interactions, measured by a meteorology package onboard the lander, are confirming some conditions observed by the Viking landers 21 years ago, while raising questions about other aspects of the planet's global system of transporting volatiles such as water vapor, clouds and dust, said science team leader Dr. Timothy Schofield. The meteorology mast on the lander has observed a rapid drop-off in temperatures just a few feet above the surface, and one detailed 24-hour measurement set revealed temperature flucuations of 30-40 degrees Fahrenheit in a matter of minutes.

In addition, sweeping, color panoramas of the Martian landscape, created by the Imager for Mars Pathfinder team and principal investigator Peter Smith, are revealing clear evidence that the surface of Mars has been altered by winds and flowing water.

Sojourner, a robust rover capable of semi-autonomous "behaviors," captured the imagination of the public, which followed the mission with great interest via the World Wide Web. Twenty Pathfinder mirror sites, constructed by JPL web engineer Kirk Goodall and managed by Pathfinder webmaster David Dubov, recorded 565 million hits worldwide during the period of July 1 -- August 4. The highest volume of hits in one day occurred on July 8, when a record 47 million hits were logged, which is more than twice the volume of hits received on any one day during the 1996 Olympic Games in Atlanta.

The rover's performance has easily surpassed its designers' minimum expectations. Engineers designed the roving vehicle's electronics, battery power and hazard avoidance features to see it through at least a week of safe roving, not knowing beforehand what conditions it might encounter on Mars. After 30 days, the rover is still healthy and has traveled 171 feet in distance, circumnavigating the lander and taking 384 spectacular views of rocks and the lander.

-more-

"Sojourner's capabilities to detect hazards and then act on its own to overcome those hazards have been remarkable," said Dr. Jacob Matijevic, Sojourner project manager. "The technology experiments we have been able to perform with the rover's wheels have given us more information about the composition of the Martian soil, as well as rocks around the landing site. Sojourner's durability in this frigid, hostile environment also is showing us that we are on the right track to building smarter, even more durable rovers for future missions."

Pathfinder's primary objective was to demonstrate a low-cost way of delivering an instrumented lander and free-ranging rover to the surface of the red planet. Landers and rovers of the future will share the heritage of spacecraft designs and technologies tested in this "pathfinding" mission.

Part of NASA's Discovery program of low-cost planetary missions with highly focused science goals, the spacecraft used an innovative method of directly entering the Martian atmosphere. Assisted by a 36-foot-diameter parachute, the spacecraft descended to the surface of Mars and landed, using airbags to cushion the impact.

This novel method of diving into the Martian atmosphere worked like a charm. "Every event during the entry, descent and landing went almost perfectly," said Richard Cook, Pathfinder mission manager. "The sequences were executed right on time and well within our margins."

Pathfinder landed right on the money, within 13 miles of the targeted landing site. The landing site coordinates in Ares Vallis were later identified as 19.33 degrees North latitude, 33.55 degrees West longitude.

The spacecraft's terminal velocity as it parachuted to the ground was higher than expected, said Rob Manning, Pathfinder flight system chief engineer. "Interestingly, we estimated our descent on the parachute at about 134 miles per hour. Software controlling the retro rockets recorded Pathfinder's speed at about 140 miles per hour at the time the rocket-assisted deceleration rockets fired."

Pathfinder's performance in the Martian atmosphere will be of great value to Mars Global Surveyor, which will aerobrake through the Martian atmosphere to circularize its orbit when it reaches Mars on September 11. The Pathfinder navigation team, led by Pieter Kallemyn of JPL, estimated that horizontal wind velocities in the upper atmosphere helped accelerate the spacecraft's descent velocity by about 20 to 25 miles per hour.

After being suspended from a 65-foot bridle and firing its retro rockets, a 19-foot diameter cluster of airbags softened Pathfinder's landing, marking the first time this airbag technique has been used on another planet. The spacecraft hit the ground at a speed of about 40 miles per hour and bounced about 16 times across the landscape for about six-tenths of a mile before coming to a halt. The airbag seems to have performed perfectly and sustained little or no damage. To top it off, the spacecraft even landed on its base petal, consequently allowing its thumb-sized antenna to communicate the successful landing to a jubilant team on Earth only three minutes after touchdown.

Science data from the surface of Mars will continue to be collected and transmitted to Earth, then analyzed by scientists, as Pathfinder enters its extended mission. The lander was placed in a two-day hibernation period earlier this week to recharge its battery after the conclusion of the primary mission, and the flight team now will begin to power the lander battery off each Martian night to conserve energy. The rover's batteries remain in good condition, but are not rechargeable.

The Mars Pathfinder mission is managed by the Jet Propulsion Laboratory for NASA's Office of Space Science, Washington, DC. JPL is a division of the California Institute of Technology, Pasadena, CA.

-end-

News Release

National Aeronautics and
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For Release

August 21, 1997

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RELEASE: 97-175

NASA SUPPORTING MARYLAND IN POCOMOKE RIVER PFIESTERIA RESEARCH

The NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, VA, is supporting the Maryland Department of Natural Resources by providing meteorological equipment to assist in the investigation into fish lesions and a recent fish kill in the Pocomoke River.

Wallops received the request for a weather station to be placed at Shelltown, MD, on Aug. 14 from John Griffin, Secretary of the Department of Natural Resources, to aid in on-site experiments. The equipment was installed on Aug. 18.

Pete Jensen, Deputy Director of Fisheries Service for the Department, said the weather equipment provided by NASA is very important in their research. Researchers are looking into a variety of factors that may contribute to the outbreak of the toxic Pfiesteria-like microorganism. One of these factors is weather, he said.

The nearest weather station to the research site at Shelltown is the Wallops Flight Facility, nearly 12 miles away. The portable NASA weather station has been located on the bank of the Pocomoke River, which will give researchers up-to-date, accurate information in the area.

The NASA weather station consists of instruments providing wind speed and direction, temperature, relative humidity, barometric pressure and precipitation. The data from the instruments are sent to an on-site computer which provides a user-friendly graphic presentation of the data and is updated every five minutes. In addition, the data are archived in the computer for retrieval by the researchers.

The NASA weather station is expected to remain on site until the Department of Natural Resources completes its research.

-end-

News Release

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For Release
August 13, 1997

RELEASE: 97-176

NEW MANUFACTURING METHOD COULD LOWER AIR TRAVEL COSTS

NASA and Boeing today demonstrated a new composites manufacturing method -- using an advanced NASA-developed stitching machine -- that is expected to have a major impact on the way aircraft wing structures are fabricated.

The demonstration took place in Huntington Beach, CA, at the new Boeing Stitched Composites Development Center. By replacing large metal structures on airplanes with composite materials, the aeronautics industry expects to achieve large savings on weight and production that should translate directly into lower airfares for the public in the near future.

Composite wing structures are expected to cost less and weigh less than aluminum wings while remaining as damage-tolerant and carrying the same loads from weight and pressure. Part of the weight and time savings come from the elimination of many of the 80,000 metal fasteners found on an aluminum wing.

"The untrained eye would only see a normal wing because it's coated in polyurethane paint," said Marvin B. Dow, a retiree from NASA's Langley Research Center, Hampton, VA, whose materials research led to the naming of the stitching facility after him. "But if you were an expert you'd notice the lack of rivet heads on the outside of the wing."

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The stitching machine sews together pre-cut knitted fabric layers at a rate of 3,200 stitches per minute, forming the shape of the wing. After the fabric pieces are stitched together, the machine sews on braided stiffener materials to add to the wing's strength. Once stitching is complete, the still-flexible wing is set with resin using a resin film infusion process.

Under the agency's new vision for its aeronautical programs, NASA is concentrating on providing the industry with innovative, sometimes dramatic, technology leaps to lower costs, increase efficiency and improve safety. The stitching machine was designed and built under the NASA Advanced Composites Technology program.

Boeing dedicated its composites development center to Dow for his 40-year career in materials research and for his invaluable work on the development of the Advanced Stitching Machine. He is the first NASA employee honored in the naming of a corporate facility. Dow retired from Langley in September 1996 and serves the center as a Distinguished Research Associate.

-end-

News Release

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For Release

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August 14, 1997

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RELEASE: 97-177

FORMER NASA OFFICIAL RECEIVES GUGGENHEIM MEDAL

Abe Silverstein, a leading figure in 20th century aerospace engineering and a former NASA center director, was presented today the prestigious Guggenheim Medal by representatives from the Guggenheim Medal Fund and the American Institute of Aeronautics and Astronautics.

The medal, established in 1927, honors those who have made significant contributions to the advancement of flight. Silverstein joins the distinguished company of previous winners that include Orville Wright, William Boeing, Donald Douglas, James Doolittle, Charles Lindbergh, James McDonnell, Jr. and Clarence "Kelly" Johnson.

Silverstein was selected to receive the award by representatives from the U.S., Canada and six European countries. Silverstein's citation praises his "technical contributions and visionary leadership in advancing technology of aircraft and propulsion performance, and foresight in establishing the Mercury and Gemini manned space flight activities."

"Lewis is an outstanding center because of the contributions made by many dedicated researchers and leaders who have gone before us. Dr. Silverstein stands head and shoulders above all others in terms of contributions in the areas of aeronautics and space. It is for this reason that he is richly deserving of the award," NASA Lewis Director Donald Campbell said.

-more-

Silverstein began his career at the National Advisory Committee for Aeronautics' (NACA) Langley Research Center, Hampton, VA, in 1929. There, he helped design and was in charge of the full-scale wind tunnel. He directed significant aerodynamic research that led to higher-speed performance for most of the United States' World War II combat aircraft.

In 1943, Silverstein was transferred to the NACA laboratory in Cleveland where he directed research in the historic Altitude Wind Tunnel that was later named for him. This work led to outstanding improvements in both reciprocating and early turbojet aircraft engines such as the development of supersonic jet afterburners. He also pioneered research on large-scale ramjet engines.

After World War II, Silverstein was instrumental in the development of U.S. supersonic propulsion wind tunnels that supported work on developed supersonic aircraft. In 1958, he moved to NACA Headquarters in Washington, DC, where he helped create and subsequently directed the efforts leading to the Mercury space flights and established the technical basis for the Apollo program to send U.S. astronauts to the Moon. He also is credited for proposing the name "Apollo" for the lunar landing program.

He returned to Cleveland to become Director of NASA's Lewis Research Center from 1961-1969. Silverstein oversaw expansion of the center and was a driving force behind creation of the Centaur launch vehicle.

-end-

News Release

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For Release
August 14, 1997

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RELEASE: 97-178

X-34 FASTRAC ENGINE PASSES CRITICAL TESTS

A critical series of tests on a rocket engine that could power the next generation of space launch vehicles has been successfully completed at the Marshall Space Flight Center in Huntsville, AL. The Fastrac engine -- only the second American made engine developed in the last 25 years -- will be the primary propulsion system for the X-34 technology demonstration vehicle scheduled to begin flight tests in late 1998.

X-34 is next in NASA's series of Reusable Launch Vehicle (RLV) technology demonstrators set for up to 25 flights beginning late next year. X-34, an air-launched vehicle being developed under contract to Orbital Sciences Corporation, Dulles, VA, is intended to demonstrate technologies ranging from composite structures and reusable propellant tanks and insulation to advanced thermal protection systems and low-cost avionics. The Mach-8 (eight times the speed of sound) craft will begin flights at the White Sands Missile Range, NM, and could include missions through inclement weather conditions in Florida, as well. X-34 demonstrations will precede the more advanced X-33 technology demonstrator scheduled to begin flights up to Mach 15 in mid-1999. A major goal of NASA's RLV efforts is to reduce dramatically the cost of putting payloads into space.

Recently completed Fastrac engine component tests evaluated the engine's thrust chamber assembly at high pressure almost identical to flight conditions. The primary combustion of propellants -- a mixture of liquid oxygen and kerosene -- occurs in the thrust chamber assembly. As the engine heats, the chamber is cooled by charring or scorching a liner inside the chamber that decomposes to prevent excessive heat buildup.

"The thrust chamber assembly performed as designed, which is another indication that the Fastrac is an engineering breakthrough," said George Young, Fastrac engine chief engineer. "Marshall engineers developed this engine in a much shorter-than-usual design cycle at significantly lower costs than a typical rocket engine."

-more-

"These tests demonstrate that a key component of our simple, low-cost engine performs in flight-like conditions," said Danny Davis, manager of the Low Cost Technologies project, which oversees the Fastrac engine. "These successful test firings of the thrust chamber mark a major milestone in the progression to low-cost space propulsion."

Each Fastrac engine initially will cost approximately $1 million -- about one-fourth of the cost of similar engines. The Fastrac provides 60,000 pounds of thrust and, in addition to the X-34 vehicle, is targeted for launch systems designed to boost payloads weighing up to 500 pounds at a dramatically lower cost.

Individual components, such as the thrust chamber assembly, gas generator and fuel tanks, are undergoing testing at Marshall. Other first-stage booster components such as tanks, propellant supply and electronic control systems and the complete engine assembly will be tested at Stennis Space Center in Mississippi beginning in early 1998.

The Fastrac engine is one element of NASA's Advanced Space Transportation Program, managed at Marshall. The program is an initiative to reduce the cost of space launch and develop technologies for space transportation needs for the next 25 years.

- end -

Contract Announcement

National Aeronautics and
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For Release
August 20, 1997

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RELEASE: C97-j

EG&G CHOSEN TO PROVIDE CENTER OPERATIONS SUPPORT SERVICES TO NASA's MARSHALL CENTER

EG&G Alabama, Inc., a division of EG&G, Inc., of Cocoa, FL, has been awarded a contract by NASA's Marshall Space Flight Center, Huntsville, AL, to provide center operations support services for a period of up to five years, beginning Sept. 1, 1997.

If all options are exercised, the contract could be worth approximately $77.8 million. This amount does not include work that could be called for under a provision in the contract that may be used to procure additional services on an indefinite-delivery, indefinite-quantity basis.

Services to be provided under the contract include operations, maintenance, renovations, modifications, construction, and environmental support services at the center.

The fixed-price, performance-based contract will be divided into a one-year base period and four one-year options that may be exercised at NASA's discretion.

The services to be provided essentially are a continuation of the effort currently being performed under the base maintenance mission services contract by BAMSI, of Titusville, FL. Excluded, however, are a few specific types of services which have been absorbed under other support service contracts.

Other companies submitting proposals were BAMSI, of Titusville, FL; BDM/Vinnell of Fairfax, VA; FKW Inc., of Oklahoma City, OK; Johnson Controls, Inc., of Cape Canaveral, FL; a joint venture between Morrison Knudsen and Call Henry, Inc., of Cocoa, FL; and Space Mark, Inc., of Colorado Springs, CO.

-end-

Video Advisory

National Aeronautics and
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Washington, DC 20546
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For Release
August 20, 1997

Debbie Rivera
Headquarters, Washington, DC
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VIDEO ADVISORY: V97-79

NEW IMAGES FROM THE RED PLANET

Today's video feed features four images of the Martian surface taken by the Pathfinder lander and Sojourner rover. The images are followed by animation of the rover operating near an area nicknamed the "rock garden".

ITEM 1: FOUR NEW MARS VIEWS
Images of the Martian surface.

For more information contact Doug Isbell at (202) 358-1753 or Skip McNevin at (818)354-5011.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
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For Release

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August 20, 1997

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RELEASE: 97-179

CASSINI LAUNCH REMAINS ON SCHEDULE

The Terminal Countdown Demonstration of the Air Force Titan IV rocket for NASA's Cassini mission has been successfully completed. Today's Terminal Countdown Demonstration was a retest after leaks were repaired on the Centaur upper stage identified during the initial demonstration on Aug. 5.

"The success of the Titan test today keeps the launch of Cassini on target for Oct. 6," said Richard Spehalski, Cassini Program Manager. "The processing of the spacecraft here at KSC has gone well and we are also on schedule."

The Cassini spacecraft is scheduled for liftoff from Cape Canaveral Air Station, Space Launch Complex 40, on Oct. 6 at 5:38 a.m. EDT. This will begin Cassini's 6.7 year journey to explore the planet Saturn.

- end -

News Release

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For Release
August 21, 1997

NOTE TO EDITORS: N97-60

AUG. 28 SPACE SCIENCE UPDATE PROVIDES FIRST LOOK AT SWIFTLY RUNNING PLASMA RIVERS INSIDE THE SUN

The discovery of enormous "rivers" of hot, electrically charged gas called plasma flowing beneath the surface of the Sun will be the subject of the next Space Science Update at NASA Headquarters, Washington, DC, at 1 p.m. EDT, Thursday, August 28.

This new finding is based on observations made by the Solar Oscillations Investigation team at Stanford University, CA, using the European Space Agency/NASA Solar and Heliospheric Observatory (SOHO) satellite. The panelists also will discuss other recent discoveries using SOHO that will help in understanding the sunspot cycle and associated increases in solar activity that can affect the Earth.

Panelists will be:
* Dr. Craig DeForest, Stanford University, CA
* Dr. Jesper Schou, Stanford University, CA
* Prof. Douglas Gough, Institute of Astronomy, University of Cambridge, U.K.
* Dr. George Withbroe, NASA Headquarters, Washington, DC, panel moderator

The update will originate from the NASA Headquarters Auditorium, 300 E St., S.W., Washington, DC, and will be carried live on NASA TV with two-way question-and-answer capability for reporters covering the event from participating NASA centers.

NASA Television is broadcast on GE-2, transponder 9C, C-Band, located at 85 degrees West longitude. The frequency is 3880.0 Mhz. Polarization is vertical and audio is monaural at 6.8 MHz. Audio of the broadcast will be available on voice circuit at the Kennedy Space Center on 407/867-1220.

-end-

Video Advisory

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For Release
August 21, 1997

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VIDEO ADVISORY: V97-80

FISHING FOR THE TRUTH

Inquiring minds want to know...has weather become a factor in the mass fish kill on the Eastern shore, particularly on the Pocomoke River in Maryland? Today's video file shows researchers from NASA's Wallops Flight Facility, VA, installing ground-based instrumentation to investigate weather's relationship to the production of the deadly microbe Pfiesteria Piscicida.

ITEM 1: FISHING FOR THE TRUTH

B-roll of technicians building a weather station for scientists.

ITEM 1a: INTERVIEW - DON PENNEY, SENIOR ELECTRONICS TECHNICIAN, POCOMOKE RIVER WEATHER STATION

Explains the data that will be available to scientists from the weather station.

ITEM 1b: INTERVIEW - PETE JENSEN, DEPUTY DIRECTOR, FISHERY SERVICE, MD

Discusses profiling the Pocomoke River.

ITEM 2: REPLAY-FOUR NEW MARS VIEWS

For more information contact Keith Koehler at (804) 824-1579.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

Douglas Isbell
Headquarters, Washington, DC
(Phone: 202/358-1753)

For Release
August 21, 1997

Jim Sahli
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-8955)

RELEASE: 97-180

MAJOR REVIEW OF MISSION TO PLANET EARTH ENDORSES FLEXIBLE APPROACH TO FUTURE SATELLITES, STEERS DATA SYSTEM DEVELOPMENT

The design process for the second and third generation of NASA's planned Earth Observing System satellites will be structured to make key decisions as late as possible in order to take best advantage of the latest science and most advanced technology available, according to a comprehensive review of the agency's Mission to Planet Earth enterprise.

The recently completed review also provided important guidance on how to phase in the deployment of the Earth Observing System (EOS) ground data system, and validated the basic plan for the first EOS atmospheric chemistry mission.

The recommendations stem from the first Mission to Planet Earth (MTPE) Biennial Review, conducted internally and then assessed by an independent external panel in response to a NASA commitment to perform such a top-to-bottom review of the enterprise every two years.

"We were impressed with the amount of enthusiasm, effort and hard thinking that went into the internal process," said Dr. Pamela Matson of the University of California at Berkeley, chair of the MTPE independent external review panel. "We believe the outcome will be an improved ability for the program to take advantage of new scientific insights, technological advances and partnering opportunities."

The goal of the EOS program is to support the maturing discipline of Earth system science by providing precise, comprehensive measurements of Earth's land, oceans, atmosphere and ice cover. Originally organized around three series of identical, large space-based platforms designed to address a wide range of scientific objectives, EOS has been evolving toward smaller, more evolutionary satellites tied to 24 specific measurements.

-more-

The results of the biennial review consolidate this evolution into a philosophy of flexible mission designs that will grow from progress in the five major MTPE science themes: land-cover and land-use change, seasonal climate variability, long-term climate change, atmospheric ozone, and natural hazards such as hurricanes and earthquakes.

"This is a major shift in the conduct of this enterprise," said William Townsend, acting associate administrator for the Mission to Planet Earth. "We are committed to meeting the measurement needs of our five science themes in the future through a combination of commercial off-the-shelf spacecraft and aggressive science instrument technology development. This will enable us to delay each post-2002 satellite procurement substantially, which allows us to learn more from ongoing missions and cut the time each mission stays in the development phase to three years or less."

In the footsteps of a February 1996 recommendation from the NASA Advisory Council to consider fundamental changes in the EOS Data and Information System (EOSDIS), the Biennial Review process also produced a plan to phase in higher-level processing of measurements from the first EOS spacecraft, called AM-1, following its scheduled June 1998 launch.

Such processing, which adds extra parameters to the basic calibrated data, would be done on a selected 25 percent of the data to start and ramp up to 100 percent over the next three years. Decisions on which data sets to process will be made by a resources board composed of EOS users, chaired by the project scientist, in close coordination with the EOS science teams.

"We strongly support the need for a targeted reduction in processing requirements," Matson said. "If done well, it will almost surely not negatively affect the science program, and will result in substantial savings that can be utilized in components of EOSDIS or the science program that turns the data into scientific understanding."

The EOS project office at NASA's Goddard Space Flight Center, Greenbelt, MD, and its industrial partner Hughes Information Technology Co., Landover, MD, will conduct an important readiness demonstration of the initial EOSDIS Core System in late August. The demonstration will show critical system functions for acquiring, archiving, processing, and distributing test data from two instruments on the AM-1 spacecraft, and for archiving and distributing data from the upcoming Landsat-7 mission.

For nearly a year, NASA has researched multi-spacecraft alternatives to the plan to purchase the first EOS Chemistry satellite (Chem-1) from TRW Space and Technology Group, Redondo Beach, CA, as part of a pair with the second EOS spacecraft, called PM-1. Due for launch in December 2002, Chem-1 carries four science instruments designed to study the transport and transformation of key atmospheric chemicals and particulates:

The NASA Advisory Council and the Biennial Review panel also agreed on the need for the MTPE enterprise to focus more effort on infusing new technology into the EOS missions to follow Chem-1. "There appears to be a commitment among MTPE managers to technology development based on science needs," Matson said. "We strongly support that requirement."

"There will be no technology development in the Mission To Planet Earth enterprise unless it is directly related to our science needs, which in many ways reverses our old way of doing business," Townsend said.

In its more general findings, the external Biennial Review panel expressed support for the principal investigator-driven approach to new small spacecraft missions under the NASA Earth System Science Pathfinder program, and it recommended an increase in MTPE research and analysis funding.

"With the Biennial Review completed and its results being incorporated into the program, this program is well positioned for the future," Townsend said. "We're looking forward to a very exciting 12 months of launches and data collection opportunities, including the start of operations for the SEAWIFS ocean color sensor and pending launches of the Lewis spacecraft, the Tropical Rainfall Measuring Mission and the first missions of the EOS era," Townsend said.

A summary of the MTPE Biennial Review results and the full letter report of the independent external review panel are available on the Internet at the following URL:

http://www.hq.nasa.gov/office/mtpe/whats_news/bi_review.html

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Video Advisory

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

For Release
August 25, 1997

Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

VIDEO ADVISORY: V97-81

A MIR WALK IN THE PARK; SIGNATURES IN SPACE

Today's video file shows highlights from the Mir Internal Spacewalk that was successfully completed on August 22. Also on NTV is b-roll of researchers from NASA's Kennedy Space Center, Florida, digitally attaching a collection of 616,000 public signatures from the United States and 80 foreign nations to the Cassini spacecraft, scheduled to launch in early October.

ITEM 1: MIR INTERNAL SPACEWALK COVERAGE
Highlights from the Mir Internal Spacewalk.

For more information contact Rob Navias at (281) 483-5111.

ITEM 2: CASSINI DISK INSTALLATION
B-roll of the Cassini signature disk installation.

ITEM 2a: INTERVIEW - CHARLES E. KOHLHASE, CASSINI SCIENCE AND MISSION DESIGN MANAGER

ITEM 2b: INTERVIEW - RICHARD J. SPEHALSKI, CASSINI PROGRAM MANAGER

For more information contact Doug Isbell at (202) 358-1753 or George Diller at (407) 867-2468.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

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Contract Announcement

National Aeronautics and
Space Administration

Washington, DC 20546
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Douglas Isbell
Headquarters, Washington, DC
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John Watson
Jet Propulsion Laboratory, Pasadena, CA
(Phone: 818/354-5011)

For Release
August 26, 1997

RELEASE: C97-k

OAO CORP. SELECTED BY NASA JET PROPULSION LABORATORY FOR DESKTOP/NETWORK CONTRACT

NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA, has selected OAO Corp., Greenbelt, MD, for negotiations to perform JPL's institutional computing management contract.

With extensions, the desktop and network services contract encompasses up to ten years and more than $200 million in services, making this JPL's largest outsourcing contract to date and the first time such JPL functions have been fulfilled by a contractor. Negotiations are ongoing, with signature slated for Oct. 31 and implementation for mid-December.

As JPL's outsourcing partner on the five-year computer services contract, which includes options for up to five additional years, OAO will initially manage hardware and software for 7,000 of JPL's 12,000 desktop computer stations. The fixed-price, performance-based contract covers help-desk services, systems administration, software acquisitions and upgrades, computer hardware maintenance, and hardware replenishment.

"We're very pleased to have been able to select OAO for negotiations," said JPL Deputy Director Larry Dumas. "This type of contract reflects a new emphasis at JPL in partnering with industry to carry out our mission, focusing our workforce on one-of-a-kind tasks that are appropriate to a national laboratory."

-more-

For this contract, OAO has formed the DNS Alliance, which includes subcontractors Digital Equipment Corp., Maynard, MA; Hewlett-Packard Co., Palo Alto, CA; and User Technology Associates, Arlington, VA, all of whom will bring their resources to bear to help fulfill various aspects of the contract. OAO, formed in 1973, is an information technology firm that has provided services to JPL on Mars Pathfinder, Galileo and the upcoming Cassini mission, among others.

More than 130 personnel, 50 of whom are JPL employees and the remainder employed by companies having various computer-related contracts with JPL, will be affected, including systems administrators, hardware maintenance technicians, network engineers and computer programmers. They will be given the option of becoming OAO employees with salary packages equivalent to or surpassing their current salaries and guaranteed OAO employment for a minimum of one year. In addition, JPL employees will be allowed to transfer their JPL seniority to OAO; a three-year JPL employee, for example, will begin at OAO with three years of seniority and will be eligible for any benefits that other OAO employees with three years of service receive.

Upon startup of the contract, ownership of hardware will continue under JPL jurisdiction but, through a progressive replenishment plan upgrading covered workstations with OAO computers approximately every 36 months, the Maryland firm is scheduled to own all covered hardware by the end of the year 2000.

JPL is managed for NASA by the California Institute of Technology.

-end-

Video Advisory

National Aeronautics and
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For Release
August 26, 1997

Debbie Rivera
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VIDEO ADVISORY: V97-82

AIRPORT SAFETY DURING STORM OR DARK OF NIGHT

Today's video file shows NASA's airplane technology that will keep air traffic moving safely and efficiently day or night, regardless of visibility. NASA's Boeing 757 research aircraft will be demonstrating the airborne systems and displays in flight tests at the Hartsfield-Atlanta airport. The overall effort is called Low Visibility Landing and Surface Operations, a program led by NASA's Langley Research Center, Hampton, VA.

ITEM 1: CLEAR ROUTE FOR PILOTS
Footage includes taxiing at Dulles International Airport and Hartsfield-Atlanta International as well as interior shots of NASA's 757 showing the systems and displays.

ITEM 1a: INTERVIEW - DENISE JONES, PRINCIPAL INVESTIGATOR
Jones discusses the benefits of Low Visibility Landing and Surface Operations.

ITEM 1b: INTERVIEW - STEVE YOUNG, CO-PRINCIPAL INVESTIGATOR

For more information contact Keith Henry at (757) 647-2133 or Dwayne Brown at (202) 358-1726.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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For Release
August 26, 1997

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RELEASE: 97-181

NASA TESTS CONCEPTS FOR LOW-VISIBILITY AIRPORT OPERATIONS

NASA today began demonstrating aircraft technology on the runways and taxiways of Hartsfield-Atlanta International Airport that promises to keep commercial airplane traffic moving safely and efficiently day or night, regardless of visibility.

The technology actually is many technologies integrated into one overall system. On the ground is a system of ground surveillance sensors and other equipment developed by the Federal Aviation Administration (FAA). Onboard NASA's Boeing 757 research aircraft are the airborne systems and displays.

The research program calls for a total of 53 flight tests and demonstrations at Hartsfield-Atlanta to be completed by the end of August. Demonstrations will be to various airline and industry executives, officials of the FAA, and other government agencies.

"The idea is to demonstrate the feasibility of safely performing low-visibility operations at capacities that currently are performed in clear weather," said Steve Young, flight test co-principal investigator from NASA's Langley Research Center, Hampton, VA. "We've all experienced what happens to the air traffic system when weather slows traffic at an airport; and the trend is toward more traffic delays. This work has the potential to slow that trend as well as improve safety."

-more-

The research is part of NASA's seven-year Terminal Area Productivity program begun in 1994, led by NASA's Ames Research Center, Moffett Field, CA. The program is part of the Agency's aviation system capacity program, expected to increase substantially aviation system traffic capacity in all weather conditions.

For the Atlanta effort, dubbed the Low Visibility Landing and Surface Operations program, the cockpit display system is an integration of two subsystems. The Roll-out Turn-off guidance subsystem was developed at Langley and aids the pilot in roll-out (touchdown and rolling down the runway) and turn-off (exiting the runway onto the taxiway). The Taxiway Navigation and Situation Awareness display subsystem was developed by Ames and is being used in the Atlanta deployment as a pilot aid during taxiing.

As the research aircraft approaches the runway, computer-generated graphics outline the correct runway and its precise location on a glass visor mounted between the pilot and the cockpit windshield. Upon contact with the ground, the pilot's aircraft position and that of other aircraft are shown on an electronic moving map of the airport on the instrument panel. With Global Positioning System (GPS) satellite positioning and an airport layout database, the displays are updated in real time. During roll-out and turn-off from the runway, the head-up display provides the pilot with guidance so that runway occupancy time is minimized.

The glass visor, or head-up display, shows the edges of the runway and taxiway with a series of computer-generated "cones" in a virtual reality manner. During taxiing, a turn is indicated by virtual cones and signs showing the angle and direction of the turn. As the pilot taxis, the virtual cones and signs move and change as if they were actual objects on the taxiway. The pilot's cleared route looks like a virtual highway on the ground.

"Earlier studies with the Ames display system have shown that making it available to the pilot virtually eliminates the kind of navigation errors that crop up in low visibility conditions, when the pilot has trouble seeing surface signage and other salient landmarks," said Ames co-principal investigator Robert McCann.

Ground-based components consist of a surveillance system that provides traffic positions to the 757 via a computer datalink and a controller interface that allows air traffic controllers to transmit instructions to the aircraft by computer in parallel with normal voice communications. The controller also is automatically informed via this computer link if the 757 deviates from its approved path.

A combined ground and airborne system can reduce the growing number of ground accidents and close calls by increasing the situational awareness of both pilots and controllers. Additionally, the digital datalink greatly eliminates the possibility of miscommunication between controller and pilot.

Other flight demonstration team members are Rockwell International, Cedar Rapids, IA; Cardion, Inc., Woodbury, NY; St. Cloud State University, St. Cloud, MN; Volpe National Transportation Systems Center, Cambridge, MA; Jeppesen Sanderson, Englewood, CO; Trios Associates, Inc., Greenbelt, MD; Project Management Enterprises, Inc., Bethesda, MD; Rannoch Corp., Alexandria, VA; and QuesTech, Inc., Falls Church, VA.

EDITOR'S NOTE: A color photo of the low-visibility system is available for media representatives by calling the Headquarters Imaging Branch on 202/358-1900. Photo number is 97-HC-592.

-end-

News Release

National Aeronautics and
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Douglas Isbell
Headquarters, Washington, DC
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For Release

August 26, 1997

Sally Koris
TRW Space & Electronics Group, Redondo Beach, CA
(Phone 310/812-4721)

RELEASE: 97-182

LEWIS SPACECRAFT ENCOUNTERS DIFFICULTIES

NASA's Earth-orbiting Lewis spacecraft has entered a spin that has disrupted the spacecraft's power-generating capability, raising the potential of the loss of the mission.

Lewis was launched successfully on Aug. 22 at 11:51 p.m. PDT from Vandenberg Air Force Base, CA, aboard a Lockheed Martin Launch Vehicle (LMLV-1). Built by TRW Space & Electronics Group, Redondo Beach, CA, Lewis is part of NASA's Small Spacecraft Technology Initiative.

Initial operations and check-out of Lewis were proceeding satisfactorily until telemetry received at 6 a.m. EDT today at the mission's Chantilly, VA, control center indicated that the spacecraft was spinning at approximately two revolutions per minute. Preliminary indications are that excessive thruster firing had occurred on one side of the spacecraft, causing it to spin when it should be stable on all three axes.

The solar arrays on Lewis were unable to generate full power due to the spinning motion, and the batteries were discharged below operational levels. Four subsequent attempts to contac the spacecraft were unsuccessful.

"The excellent performance of the launch vehicle put Lewis into an optimal circular parking orbit that provides us with a minimum of three weeks to try to resolve this anomaly," said Samuel Venneri, Chief Technologist at NASA Headquarters in Washington. "In addition, Lewis carries several autonomous systems onboard that raise the possibility that it can correct itself and recharge the batteries. NASA and TRW are working hard to assess and better understand the situation, in order to establish a recovery plan and try to resume the mission."

-more-

Outfitted with advanced technology Earth-imaging instruments and subsystems intended to push the state-of-the-art in scientific and commercial remote sensing, Lewis features remote sensing instruments designed to split up the spectrum of light energy reflected by Earth's land surfaces into as many as 384 distinct bands. Potential commercial applications include pollutant monitoring, analysis of endangered species habitats, estimation of forest and agricultural productivity, soil resources and crop residue mapping, and assessments of environmental impacts from energy pipelines.

The total cost to NASA of the Lewis mission, including its launch vehicle and one year of orbital operations, is $64.8 million. NASA incurred an additional cost of $6.2 million for storage and maintenance of the spacecraft during a one-year delay due to launch vehicle issues.

Lewis is part of NASA's Mission to Planet Earth enterprise, a long-term research program designed to study the Earth's land, oceans, air and life as a total system.

-end-

Video Advisory

National Aeronautics and
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Washington, DC 20546
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Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

For Release
August 27, 1997

VIDEO ADVISORY: V97-83

ENGINE CONTROL SYSTEM MAY HELP PREVENT STALLS AND FAILURES

Today's video feed features a NASA flight demonstration that can sense and respond to high levels of engine inlet, turbulence or distortion thus preventing sudden engine stalls and failures. The result will provide higher performance and better fuel efficiency in military and commercial aircraft.

ITEM 1: HIGH PERFORMANCE AIRCRAFT

B-roll of the F-15 take-off and air-to-air footage.

ITEM 1a: INTERVIEW - JOHN DELAAT, HIGH STABILITY ENGINE CONTROL, PROGRAM MANAGER

DeLaat explains the benefits of the High Stability Engine Control System.

For more information contact Dwayne Brown at (202) 358-1726 or Lori Rachul at (216) 433-8806.

ITEM 2: REPLAY- CLEAR ROUTE FOR PILOTS

ITEM 2a: INTERVIEW - DENISE JONES, PRINCIPAL INVESTIGATOR

ITEM 2b: INTERVIEW - STEVE YOUNG, CO-PRINCIPAL INVESTIGATOR

For more information contact Dwayne Brown at (202) 358-1726 or Keith Henry at (757) 647-2133.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

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News Release

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For Release

August 27, 1997

RELEASE: 97-183

**NASA RESEARCHING ENGINE AIRFLOW CONTROLS
TO IMPROVE PERFORMANCE, FUEL EFFICIENCY**

NASA is conducting flight demonstrations of an advanced high-stability engine-control system that is expected to increase significantly future propulsion system performance in both military and commercial aircraft turbine engines.

Under the High Stability Engine Control project, NASA's Lewis Research Center, Cleveland, OH, and Dryden Flight Research Center, Edwards, CA, are working together to evaluate a computerized system that can sense and then respond to high levels of engine inlet airflow turbulence or distortion, thereby preventing sudden in-flight engine compressor stalls and potential engine failures.

The system, called Distortion Tolerant Control, incorporates an aircraft mounted, high-speed processor that senses changes in airflow at the front of the engine and allows the system to automatically command trim changes to the engine to accommodate changing distortion conditions. This allows the engines to operate with more stability under adverse or turbulent airflow conditions.

"The primary benefit of Distortion Tolerant Control is its ability to set the stability margin requirement on-line and in real-time," said John DeLaat, program manager at Lewis. "This can allow the built-in stall margin to be reduced, which can then be traded for increased performance, decreased weight, or both. The result will be higher-performance military aircraft and more fuel-efficient commercial airliners," he added.

-more-

The High Stability Engine Control system is being flight tested at Dryden on a highly modified F-15 jet, which is exploring a variety of advanced control system technologies. The F-15's right engine has been heavily instrumented for the engine experiment, while its left engine remains in the standard configuration.

"The F-15 aircraft is an ideal flight research testbed for advanced technologies such as this system," said John Orme, Dryden's principal investigator for the system. "The aircraft's fly-by-wire control system allows for minimum modifications to integrate research systems. Additionally, propulsion testing on only one of the two engines reduces the flight safety risk inherent with most new technologies."

The flight demonstrations of the engine experiment are being conducted in two phases. The first "open loop" phase, completed Aug. 8, focused on gathering baseline data on inlet airflow distortion. The second "closed loop" phase, which concludes at the end of August, feeds that data into a Stability Management Control device in the aircraft's electronic engine control computer, which then gives trim commands to the right engine to accommodate for airflow distortion.

Project pilots are flying the modified F-15 through a variety of maneuvers designed to create unstable or distorted airflow conditions in the engine air inlets, including nose high angles (angle of attack) up to 25 degrees, full-rudder sideslips, wind-up turns, split-S descents and simulated fighter maneuvering. Test-point speeds range from Mach 0.3 to Mach 1.6, at altitudes from 5,000 to 45,000 feet.

The High Stability Engine control research is sponsored and managed by Lewis, while Dryden is in charge of the flight test phase. Partners include engine manufacturer Pratt & Whitney, West Palm Beach, FL; Boeing Phantom Works (formerly McDonnell Douglas), St. Louis, MO; and the U.S. Air Force's Wright Laboratories, Wright-Patterson AFB, OH, which owns the aircraft and provided one of the five pilots who flew the missions.

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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Franklin O'Donnell
Jet Propulsion Laboratory, Pasadena, CA
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For Release

August 28, 1997

NOTE TO EDITORS: N97-62

CASSINI PRELAUNCH SCIENCE BRIEFING SCHEDULED FOR SEPTEMBER 3

Representatives from the international team now making final preparations to launch the Cassini mission to Saturn will conduct a televised media briefing on the mission and its science goals on Wednesday, Sept. 3, at 1 p.m. EDT. The briefing will originate from NASA Headquarters, Washington, DC.

Cassini is scheduled for liftoff at 5:38 a.m. EDT on Oct. 6, 1997, aboard a Titan-4B/Centaur launch vehicle from Cape Canaveral Air Station, FL. With an on- time launch, it will arrive in orbit around Saturn on July 1, 2004, for at least four years of close-up studies of the ringed planet and its 18 known moons. The mission will include the deployment of the European Space Agency-built Huygens probe into the atmosphere of the hazy moon Titan.

Two panels of Cassini scientists and engineers will make presentations, with each panel followed by a question-and-answer session with participating media.

PANEL 1 -- MISSION SCIENCE
Dr. Wesley T. Huntress Jr., NASA Associate Administrator for Space Science
Richard Spehalski, Cassini Program Manager, Jet Propulsion Laboratory (JPL), Pasadena, CA
Dr. Dennis Matson, Cassini Project Scientist, JPL
Dr. Jean-Pierre Lebreton, Huygens Project Scientist, European Space Agency (ESA)
Dr. Jonathan Lunine, Cassini Interdisciplinary Scientist, University of Arizona, Tucson
Dr. Carolyn Porco, Cassini Imaging Team Leader, University of Arizona
Dr. Larry Soderblom, Cassini Interdisciplinary Scientist, U.S. Geological Survey, Flagstaff, AZ

-more-

PANEL 2 -- MISSION HARDWARE
Richard Spehalski, JPL
Hamid Hassan, Huygens Project Manager, ESA
Enrico Flamini, Cassini Project Manager, Italian Space Agency
Beverly Cook, Program Manager, Space Radioisotope Power Systems, Department of Energy, Germantown, MD

Extensive information on Cassini, including mission-related images, is available on the Internet at the following URL:

http://www.jpl.nasa.gov/cassini/

NASA Television is located on GE-2, transponder 9C at 85 degrees West longitude, vertical polarization, with a frequency of 3880 Mhz, and audio of 6.8 Mhz. There will be two-way question and answer capability for media at participating NASA centers.

-end-

Video Advisory

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

For Release
August 28, 1997

Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

VIDEO ADVISORY: V97-84

INSIDE SPEKTR; RED RIVERS IN THE SUN; EARTH'S MEASURING UP

Today's video feed features footage taken by Cosmonaut Pavel Vinogradov inside Mir's Spektr module following the successful internal spacewalk on August 22. Also on NTV, scientists have discovered "rivers" of plasma--hot, electrically charged gas, flowing under the Sun's surface--while working with data from NASA and ESA's Solar Heliospheric Observatory (SOHO) spacecraft. Finally, NTV will feature b-roll of the first spacecraft in the Earth Observing System series, which will measure the Earth's energy balance.

ITEM 1: INSIDE SPEKTR - FIRST FEED AT TOP OF 3 P.M. FILE

Greenhouse footage follows, showing maturation of tomato plants.

For more information contact Rob Navias at (281) 483-5111.

ITEM 1: PLASMA RIVERS RUN SWIFTLY INSIDE THE SUN
ITEM 1a: LAYERS UNDER THE SUN
ITEM 1b: SOHO ANIMATION
ITEM 1c: SUN SPOTS
ITEM 1d: SOLAR HICCUP
ITEM 1e: INTERVIEW - DR. CRAIG DEFOREST, RESIDENT OBSERVER, STANFORD UNIVERSITY

For more information contact Don Savage at (202)358-1727.

ITEM 2: EARTH'S ENERGY BALANCE

For more information contact Doug Isbell at (202)358-1753 or Allen Kenizter at (301) 286-2806.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

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News Release

National Aeronautics and
Space Administration
Washington, DC 20546
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For Release

Donald Savage
Headquarters, Washington, DC
(Phone: 202/358-1547)

August 28, 1997
EMBARGOED UNTIL 1 PM EDT

Bill Steigerwald
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-8955)

RELEASE: 97-184

SCIENTISTS DISCOVER MASSIVE JET STREAMS FLOWING INSIDE THE SUN

Scientists using the joint European Space Agency (ESA)/NASA Solar and Heliospheric Observatory (SOHO) spacecraft have discovered "jet streams" or "rivers" of hot, electrically charged gas called plasma flowing beneath the surface of the Sun. They also found features similar to trade winds that transport gas beneath the Sun's fiery surface.

These new findings will help them understand the famous sunspot cycle and associated increases in solar activity that can affect the Earth with power and communications disruptions. The observations are the latest made by the Solar Oscillations Investigation (SOI) group at Stanford University, Palo Alto, CA, and they build on discoveries by the SOHO science team over the past year.

"We have detected motion similar to the weather patterns in the Earth's atmosphere," said Dr. Jesper Schou of Stanford. "Moreover, in what is a completely new discovery, we have found a jet-like flow near the poles. This flow is totally inside the Sun. It is completely unexpected, and cannot be seen at the surface."

"These polar streams are on a small scale, compared to the whole Sun, but they are still immense compared to atmospheric jet streams on the Earth," added Dr. Philip Scherrer, the SOI principal investigator at Stanford. "Ringing the Sun at about 75 degrees latitude, they consist of flattened oval regions about 17,000 miles across where material moves about 10 percent (about 80 mph) faster than its surroundings. Although these are the smallest structures yet observed inside the Sun, each is still large enough to engulf two Earths."

-more-

Additionally, there are features similar to the Earth's trade winds on the surface of the Sun. The Sun rotates much faster at the equator than at the poles. However, Stanford researchers Schou and Dr. Alexander G. Kosovichev have found that there are belts in the northern and southern hemispheres where currents flow at different speeds relative to each other. Six of these gaseous bands move slightly faster than the material surrounding them. The solar belts are more than 40 thousand miles across and they contain "winds" that move about ten miles per hour relative to their surroundings.

The first evidence of these belts was found more than a decade ago by Dr. Robert Howard of the Mount Wilson Observatory. The Stanford researchers have now shown that, rather than being superficial surface motion, the belts extend down to a depth of at least 12,000 miles below the Sun's surface.

"In one way, the Sun's zonal belts behave more like the colorful banding found on Jupiter than the region of tradewinds on the Earth," said Stanford's Dr. Craig DeForest. "Somewhat like stripes on a barber pole, they start in the mid-latitudes and gradually move toward the equator during the eleven-year solar cycle. They also appear to have a relationship to sunspot formation as sunspots tend to form at the edges of these zones.

"We speculate that the differences in speed of the plasma at the edge of these bands may be connected with the generation of the solar magnetic cycle which, in turn, generates periodic increases in solar activity, but we'll need more observations to see if this is correct," said DeForest.

Finally, the solar physicists have determined that the entire outer layer of the Sun, to a depth of at least 15,000 miles, is slowly but steadily flowing from the equator to the poles. The polar flow rate is relatively slow, about 50 miles per hour, compared to its rotation speed, about 4,000 miles per hour; however, this is fast enough to transport an object from the equator to the pole in a bit more than a year.

"Oddly enough, the polar flow moves in the opposite direction from that of the sunspots and the zonal belts, which are moving from higher to lower latitudes," said DeForest.

Evidence for polar flow previously had been observed at the Sun's surface, but scientists did not know how deep the motion extended. With a volume equal to about 4 percent of the total Sun, this feature probably has an important impact on the Sun's activity, argue Stanford researchers Scherrer, with Dr. Thomas L. Duvall Jr., Dr. Richard S. Bogart, and graduate student Peter M. Giles.

For the last year, the SOHO spacecraft has been aiming its battery of 12 scientific instruments at the Sun from a position 930,000 miles sunward from the Earth. The Stanford research team has been viewing the Sun's surface with one of these instruments called a Michelson Doppler Imager that can measure the vertical motion of the Sun's surface at one million different points once per minute. The measurements show the effects of sound waves that permeate the interior. The researchers then apply techniques similar to Earth-based seismology and computer-aided tomography to infer and map the flow patterns and temperature beneath the Sun's roiling surface.

"These techniques allow us to peer inside the Sun using sound waves, much like a doctor can look inside a pregnant woman with a sonogram," said Dr. Schou.

Currently, the Stanford scientists have both identified new structures in the interior of the Sun and clarified the form of previously discovered ones. Understanding their relationship to solar activity will require more observations and time for analysis.

"At this point, we do not know whether the plasma streams snake around like the jet stream on Earth, or whether it is a less dynamic feature," said Dr. Douglas Gough, of Cambridge University, UK. "It is intriguing to speculate that these streams may affect solar weather like the terrestrial jetstream impacts weather patterns on Earth, but this is completely unclear right now. The same speculation may apply to the other flows we've observed, or they may act in concert. It will be especially helpful to make observations as the Sun enters its next active cycle, expected to peak around the year 2001."

- end -

Images to support this story can be found at the following Internet address:

http://pao.gsfc.nasa.gov/gsfc/newsroom/flash/flash.htm

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

Douglas Isbell
Headquarters, Washington, DC
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For Release
August 28, 1997

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RELEASE: 97-185

MAJOR EARTH SCIENCE SPACECRAFT REACHES CRITICAL MILESTONE

The first of NASA's Earth Observing System (EOS) Spacecraft, EOS AM-1, has reached a critical milestone with the delivery of its last science instrument, allowing completion of module testing and integration of the instruments and the spacecraft. The last instrument arrived on Aug. 25.

EOS AM-1 begins a new generation of Earth science - one that studies the Earth as a global system. EOS will carry a complement of five synergistic instruments. "We're absolutely thrilled to reach this milestone," said Dr. Robert Price, Director of NASA's Mission to Planet Earth Program Office at the Goddard Space Flight Center, Greenbelt, MD. "We're now well on our way to having the spacecraft ready for its June 1998 launch."

The next critical step for EOS AM-1 is to complete systems tests which validate the ability of the integrated spacecraft to withstand the harsh environment of space and to work with its ground system. Following that, the spacecraft will be delivered to Vandenberg Air Force Base, CA, for launch processing.

The EOS AM-1 spacecraft is being assembled and tested by Lockheed-Martin at its Valley Forge, PA, production facility.

The EOS series spacecraft are the cornerstone of NASA's Mission to Planet Earth (MTPE) Enterprise, a long-term coordinated research effort to study the Earth as a global system and the effects of natural and human-induced changes on the global environment. EOS AM-1 will use this unique perspective from space to observe the Earth's continents, oceans and atmosphere with five state-of-the-art instruments with measurement capability and accuracy never flown before. This unique approach enables scientists to study the interactions among these three components of the Earth system, which determine the cycling of water and nutrients on Earth.

-more-

"EOS AM-1 will study simultaneously clouds, water vapor, aerosol, particles, trace gases, terrestrial and oceanic properties, the interaction between them and their effect on atmospheric radiation and climate," said Dr. Yoram Kaufman, EOS AM-1 project scientist. "Moreover, EOS AM-1 will observe changes in Earth's radiation energy budget, together with measurements of changes in land/ocean surface and interaction with the atmosphere through exchanges of energy, carbon, and water. Clearly comprehending these interactive processes is essential to understanding global climate change," he said.

A polar-orbiting spacecraft, EOS AM-1 is scheduled for launch in June 1998 aboard an Atlas-Centaur IIAS launch vehicle from Vandenberg AFB. Because the AM series emphasizes observations of terrestrial surface features, its orbit is designed to cross the equator at 10:30 a.m., when cloud cover is minimalized.

The Cloud's and the Earth's Radiant Energy System (CERES) instrument will perform measurements of the Earth's "radiation budget," or the process in which the Earth's climate system constantly tries to maintain a balance between the energy that reaches the Earth from the Sun, and the energy that goes from Earth back out to space. The components of the Earth system that are important to the radiation budget are the planet's surface, atmosphere, and clouds.

The Multi-Angle Imaging Spectroradiometer (MISR) will measure the variation of the surface and cloud properties with the view angle. Meanwhile, the Moderate-Resolution Imaging Spectroradiometer (MODIS) will measure atmosphere, land and ocean processes, including surface temperature of both the land and ocean, ocean color, global vegetation, cloud characteristics, temperature and moisture profiles, and snow cover. The Measurements of Pollution in the Troposphere (MOPITT) instrument is an infrared gas-correlation radiometer that will take global measurements of carbon monoxide and methane in the troposphere. The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) will measure cloud and vegetation properties, surface mineralogy, soil properties, surface temperature, and surface topography for selected regions of the Earth.

The CERES, MISR, and MODIS instruments are provided by the United States; MOPITT by Canada; and ASTER by Japan. Several hundred scientists from the U.S. and abroad have been preparing to take full advantage of EOS AM-1 observations to address key scientific issues and their environmental policy impacts.

EOS is managed by Goddard for NASA's Mission to Planet Earth strategic enterprise, Washington, DC.

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EDITOR'S NOTE: For more information on EOS, access the EOS AM Project Homepage at URL:

http://eos-am.gsfc.nasa.gov

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
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For Release

August 29, 1997

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RELEASE: 97-186

NEW X-RAY GENERATOR TO IMPROVE PROTEIN CRYSTAL RESEARCH ON SPACE STATION

A collaborative effort by NASA, university researchers and industry has resulted in the development of a new X-ray generator to speed the collection of protein structure information from crystals grown aboard the International Space Station.

Researchers grow protein crystals in space because the crystals typically grow larger and with greater purity in the near-weightless environment of low-Earth orbit, providing researchers better data for structure-based drug design.

The X-ray device is a critical component of the X-ray Crystallography Facility, a payload planned for the International Space Station, being designed and developed by the University of Alabama in Birmingham's Center for Macromolecular Crystallography.

Using the X-ray generator in the commercially developed X-ray Crystallography Facility will alleviate the need to return space-grown crystals to Earth for further analysis. By measuring and mapping the crystal's structure in space, researchers will avoid exposing the delicate crystals to the rigors of space travel, and important research data will be available to scientists much faster.

The X-ray generator, developed by Bede Scientific Instruments Ltd. in Durham, Great Britain, is a compact, lightweight, low-power X-ray device about the size of a small suitcase and is capable of generating high-brightness X-ray sources for protein crystal growth research. The generator focuses X-ray beams approximately one-half millimeter in diameter on the targeted protein crystal, allowing researchers to analyze and model the three-dimensional structure of protein molecules in detail, previously only possible with sources using sixty times the power.

- more -

Dr. Larry DeLucas, Director of the Center for Macromolecular Crystallography and a former Space Shuttle payload specialist, stated that having an X-ray facility aboard the Space Station will improve our understanding of effects of low-Earth orbit on crystal growth and contribute to accelerated drug development.

"Providing a three-dimensional structure is what we're after," said DeLucas. "Once we determine a protein structure, it provides a wealth of information regarding the mechanism of the protein and, in many cases, this information is used to design new and more effective pharmaceuticals. This new X-ray facility will help to speed the process by allowing scientists to use the Space Station to grow the crystals and collect the X-ray data in space."

Current X-ray crystallography facilities are about the size of an automobile. The new X-ray facility being developed for the Space Station will fit into a single space station rack -- about the size of a household refrigerator -- and will produce the same intensity of X-rays.

Bede Ltd. built the new X-ray instrument in collaboration with the Center for Macromolecular Crystallography, which is under contract to NASA's Microgravity Research Program's Space Product Development Office at NASA's Marshall Space Flight Center, Huntsville, AL.

A unique aspect of the X-ray crystallography facility is its commercial development approach. The funding for further development of this facility will be provided by non-U.S. Government sources, thereby reducing the cost for taxpayers.

DeLucas said, "I can't begin to tell you how much we are looking forward to continuing our work aboard the new Space Station. This brings us one step closer to making the facility a reality. With the X-ray facility onboard, we'll have a new and powerful potential tool to address many public health problems."

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News Release

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release

August 29, 1997

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RELEASE: 97-187

NASA TEAM APPOINTED TO INVESTIGATE MAIN ENGINE TEST STAND FIRE

NASA Headquarters Associate Administrator for Space Flight Wilbur C. Trafton has appointed a major incident investigation board to determine the cause of a fire that occurred on a developmental Space Shuttle main engine being tested at NASA's Stennis Space Center (SSC), on Wednesday, Aug. 27, 1997.

The fire happened at approximately 3:16 p.m. EDT Wednesday on the A-1 test stand at Stennis. There were no injuries caused by the incident.

The engine being tested at the time, engine number 0524, was a developmental engine used for testing new engine components. It was not a flight engine. At 568 seconds into a planned 710-second test, the engine was operating at 109 percent power when the turbine discharge temperature exceeded its limits. This caused an automatic cutoff of the engine. At that point, or subsequent to it, a fire occurred on the stand.

What impact, if any, this incident will have to the upcoming STS-86 launch date is currently unknown. However, the Space Shuttle Main Engine (SSME) configuration used in the test was significantly different than the current SSME configuration on Shuttle Atlantis.

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The chairman of the incident investigation board will be Sid Saucier, Propulsion Lab Director, Marshall Space Flight Center (MSFC). His alternate will be Len Worlund, Space Shuttle Main Engine Chief Engineer, MSFC. Serving as members on the board will be Tony Fiorucci, Dynamics, MSFC; Parvin Aggarwal, Stress, MSFC; Mark Neely, Engine Systems, MSFC; Mike Purvey, Software and Controls, MSFC; Rob Lambdin, Materials and Processes, MSFC; Tom Hartline, Safety and Mission Assurance, MSFC; Tom Rieckhoff, Photographic Engineering Analysis, MSFC; Jim Taylor, Test Operations, SSC; Carl Kotila, Flight Systems Analysis, Johnson Space Center; and Otto Goetz, consultant with Pratt & Whitney. Other individuals may be added to the board as required.

The incident board is expected to report its findings to senior NASA managers in about 45 days.

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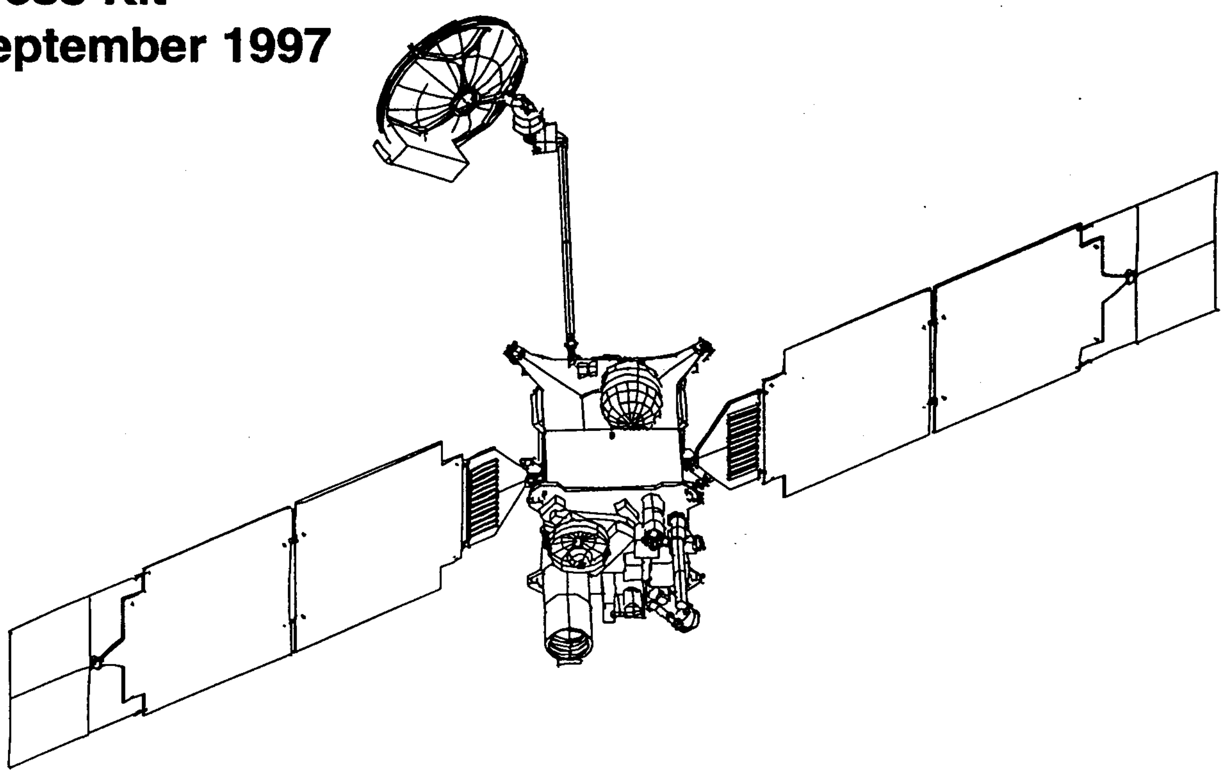
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mars Global Surveyor Arrival

Press Kit
September 1997



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Contents

RELEASE:

MARS GLOBAL SURVEYOR ON TARGET FOR ARRIVAL

NASA's Mars Global Surveyor, the first in a new series of spacecraft destined to explore the red planet, is preparing to intercept the orbit of Mars and begin a two-year mapping mission after a 10-month, 435-million-mile (700-million-kilometer) interplanetary journey.

The orbiter will fire its main engine beginning at 01:17 Universal Time on September 12 (6:17 p.m. Pacific Daylight Time September 11) for 22 minutes to slow its speed enough to be captured in orbit around the planet.

Mars Global Surveyor is a global mapping mission, carrying a suite of science instruments designed to study the entire Martian surface, atmosphere and interior. Measurements will be collected beginning in March 1998 from a low-altitude, nearly polar orbit 234 miles (378 kilometers) above the Martian surface over the course of one complete Martian year, the equivalent of nearly two Earth years.

"Throughout its primary, two-year mission, Mars Global Surveyor will gather information on the geology, geophysics and climate of Mars," said Glenn E. Cunningham, Global Surveyor project manager at NASA's Jet Propulsion Laboratory, Pasadena, CA.

"The mission will provide a global portrait of Mars as it exists today," he said. "This new view will help planetary scientists to better understand the history of Mars' evolution, and will provide clues about the planet's interior and surface evolution. With this information, we will have a better understanding of the history of all of the inner planets of the solar system, including our home planet, Earth."

Mars Global Surveyor continues NASA's long exploration of the red planet, which began more than 30 years ago with the Mariner 4 spacecraft that produced the first pictures of the planet's cratered surface. Following the successful landing of the Mars Pathfinder lander and rover on July 4, 1997, Mars Global Surveyor is the first in a multi-year series of missions called the Mars Surveyor program that will lead to eventual human expeditions to the red planet.

Mars Global Surveyor was launched at 12:00:49 p.m. Eastern Standard Time on November 7, 1996, atop a three-stage Delta II launch vehicle from launch pad 17A at Cape Canaveral Air Station, FL. The third-stage Star 48B solid rocket later propelled the spacecraft out of Earth orbit and on its way to Mars.

Once on course for the cruise to Mars, the spacecraft deployed its two solar panels to begin generating solar power. One of the solar panels did not fully deploy and is tilted about 20 degrees from its intended position; this is not, however, expected to pose a significant risk to the mission. The low-gain antenna was used for initial spacecraft communications, until the spacecraft was far enough away from Earth in early January 1997 to begin using its 5-foot-diameter (1.5-meter) high-gain antenna.

Mars Global Surveyor's six science instruments — the thermal emission spectrometer, laser altimeter, magnetometer/electron reflectometer, ultra-stable oscillator, camera and radio relay system — were calibrated during the cruise to Mars. Three trajectory correction maneuvers were performed to fine-tune the spacecraft's flight path. All spacecraft systems and the instrument payload performed well as Mars Global Surveyor headed for its destination, according to Joe Beerer, Global Surveyor flight operations manager.

When Surveyor reaches Mars, its 660-newton main engine will fire to slow the spacecraft's speed by more than 2,176 miles per hour (973 meters per second) with respect to Mars and allow the craft to be captured by Mars' gravity.

"Mars Global Surveyor will be flying over the north pole when it enters orbit around Mars," said Wayne Lee, Mars Global Surveyor mission planner. "The spacecraft will spend the first six days in this highly elliptical orbit around the planet, completing one orbit around Mars in about 45 hours, or just less than two days."

Instrument calibrations and some science measurements will take place during the elliptical orbit phase, said Dr. Arden Albee, Mars Global Surveyor project scientist.

"The spacecraft will be passing in and out of the planet's magnetic field, if indeed Mars has one, during the early and larger elliptical orbits around the planet," he said. "Global Surveyor will be able to make unique observations of interactions of magnetic field lines with the solar wind. In addition, it will make calibrations of the magnetometer and electron spectrometer that would not be possible from the lower-altitude mapping orbit.

"The thermal emission spectrometer and the camera will obtain initial observations on the surface and atmosphere of Mars," Albee continued. "These will provide valuable insight into changes in the atmosphere that might affect the safety of the spacecraft during aerobraking operations."

Six days after Mars arrival, the spacecraft will begin an innovative braking process, called aerobraking, to lower itself into a low-altitude mapping orbit. Aerobraking allows a spacecraft to use the drag of a planet's atmosphere to lower its orbit without relying on propellant. The technique was first tested in the summer of 1993, using the Magellan spacecraft orbiting Venus.

During each of its orbits shortly after Mars arrival, Mars Global Surveyor will pass through the upper fringes of the Martian atmosphere each time it reaches periapsis, the point in its orbit closest to the planet. Friction from the atmosphere will cause the spacecraft to be slowed slightly and lose some of its momentum during each orbit. Each time the spacecraft dips into the atmosphere, its one tilted solar panel will be rotated 180 degrees to protect it from folding up. As the spacecraft loses momentum, the apoapsis, or the point in its orbit farthest from

Mars, will also be lowered.

Trimming its orbit from the highly elliptical, 45-hour orbit to a nearly circular, two-hour orbit will take about four months. Five engine burns will accomplish the first orbital adjustments, lowering the periapsis (or closest point to Mars) from about 156 miles (250 kilometers) to about 69 miles (112 kilometers) above the surface.

Next, Mars Global Surveyor will spend about three months adjusting the farthest part of its orbit from 33,480 miles (54,000 kilometers) to about 1,240 miles (2,000 kilometers). As the spacecraft's orbit is trimmed, the time it takes to make one complete revolution around Mars will diminish to less than three hours.

In the final three weeks of aerobraking, Global Surveyor will raise the closest part of its orbit once again, until it is circling Mars in a 217- by 254-mile (350- by 410-kilometer) orbit, very close to the final mapping orbit. With this adjustment, the spacecraft will be orbiting Mars about once every 118 minutes, and crossing Mars' equator at about 2 p.m. local solar time each orbit.

As the spacecraft continues to circularize its orbit, the 112-foot-diameter (34-meter) antennas of NASA's Deep Space Network will be used to begin a navigation and radio science experiment, measuring small shifts in the spacecraft's velocity that will tell scientists more about the planet's gravity field.

All of the spacecraft's instruments will be turned on around March 10, 1998, and the mapping mission will begin on March 15. Data from this final checkout phase will allow the spacecraft to obtain one complete global map of the surface — a process that will take seven days — before the dust storm season begins in the spring.

"In 1998 the Martian dust storms occur roughly between February and August, so the atmosphere may be disturbed when mapping begins," Albee said. "But we may have an excellent opportunity to obtain data on the spread of a global Martian dust storm, should one occur next year."

In its final mapping orbit, Mars Global Surveyor will circle Mars at a speed of about 7,600 miles per hour (3.4 kilometers per second) in an orbit that will take it close to both poles. On the day side of the planet, Global Surveyor will be traveling from north to south. On each orbit, it will cross the equator at about 2 p.m. local mean solar time. The spacecraft will always see the surface of Mars on the daylit side as it appears at mid-afternoon. This "sun-synchronous" orbit puts the Sun at a standard angle above the horizon in each image.

Experiment teams will control their spaceborne instruments from their home institutions. Each 24 hours worth of data will be transmitted to Earth during daily, 10-hour tracking passes performed by NASA's Deep Space Network.

The Mars Global Surveyor mission is expected to yield more than 700 billion bits of scientific data, more than the amount of data returned by all previous Mars missions, and exceeded only by the Magellan Venus mission.

Mars Global Surveyor will examine the entire planet — from the ionosphere, an envelope of charged particles surrounding Mars, down through the atmosphere to the surface and deep into Mars' interior. Scientists will glean valuable new information on daily and seasonal weather patterns, geological features and the migration of water vapor from hemisphere to hemisphere over a complete Martian year.

As the primary mission winds down in late 1999, Global Surveyor will be used to relay data from microprobes penetrators beneath the surface of Mars that will have been deployed before arrival by the 1998 Mars Surveyor, and will be used as a backup relay platform for data from the Mars Surveyor '98 lander itself. Depending on its lifetime, Global Surveyor may also serve as a communications relay station for other spacecraft arriving at Mars.

Mars Global Surveyor is the first mission in a sustained program of robotic exploration of Mars, managed by the Jet Propulsion Laboratory, Pasadena, CA, for NASA's Office of Space Science, Washington, DC. JPL is a division of the California Institute of Technology.

[End of General Release]

Media Services Information

NASA Television Transmission

NASA Television is broadcast on the satellite GE-2, transponder 9C, C Band, 85 degrees west longitude, frequency 3880.0 MHz, vertical polarization, audio monaural at 6.8 MHz. Television coverage of the Mars Global Surveyor orbit insertion begins at 5 p.m. Pacific Daylight Time on Sept. 11 and concludes at approximately 8:30 p.m. PDT, following a live news briefing. The schedule for NASA TV programming is available from the Jet Propulsion Laboratory, Pasadena, CA; Johnson Space Center, Houston, TX; Kennedy Space Center, FL; and NASA Headquarters, Washington, DC.

Status Reports

Status reports on Mars Global Surveyor will be issued by the Jet Propulsion Laboratory's Public Information Office. They may be accessed online as noted below. Daily audio status reports are available by calling (800) 391-6654.

Briefings

A pre-arrival mission and science overview briefing, originating from the Jet Propulsion Laboratory, will be carried live on NASA TV at 10 a.m. Pacific Daylight Time on Tuesday, September 9. Status briefings will be held at 10 a.m. PDT Wednesday and Thursday, September 10-11. A post-arrival briefing will be held at 7:40 p.m. PDT Thursday, September 11. A briefing presenting initial science findings is tentatively scheduled the week of September 22-26.

Image Releases

Images returned by Mars Global Surveyor will be released to the news media in electronic format only during the mission. The images will be available in a variety of file formats from the JPL home page at **http://www.jpl.nasa.gov** . Images will also be distributed from the Mars Orbiter Camera principal investigator's web site at **http://www.msss.com** .

Internet Information

Extensive information on Mars Global Surveyor — including an electronic copy of this press kit, as well as news releases, fact sheets, status reports, spacecraft and science data and images — is available from the Jet Propulsion Laboratory's World Wide Web home page at **http://www.jpl.nasa.gov** . The Mars Global Surveyor Project also maintains a home page at **http://marsweb.jpl.nasa.gov** . Data from all of the mission's science instruments will be available on the home pages of each instrument's principal investigator; these addresses are linked to the Mars Global Surveyor project's home page.

Quick Facts

Spacecraft

Dimensions: Main structure 4 by 4 by 6 feet (1.2 by 1.2 by 1.8 meters); 40 feet (12 meters) across with fully deployed solar panels
Spacecraft mass at Mars arrival: 1,691 lbs (767 kg)
Science instruments: thermal emission spectrometer; laser altimeter; magnetometer/electron reflectometer; ultra-stable oscillator; camera; radio relay system
Solar arrays: 2 panels, each 11 feet (3.5 meters) long; power 980 watts maximum; cells composed of gallium arsenide and silicon
Radio: 25-watt transmitter, X-band (8 GHz)
High-gain antenna diameter: 4.9 feet (1.5 meters)

Launch/Cruise

Launch: 12:00:49 p.m. Eastern Standard Time (17:00:49 Universal Time) November 7, 1996, from Cape Canaveral Air Station, FL
Cruise: 10 months

Mars Orbit Insertion

Orbit insertion burn: Begins 01:17:16 and ends at 01:39:33 Universal Time on Sept 12, 1997 (6:17 p.m. to 6:39 p.m. Pacific Daylight Time Sept 11, 1997); duration 22 min, 17 sec
One-way speed of light time on arrival day: 14 minutes, 6 seconds
Time burn observed on Earth: Begins 6:31 p.m. and ends 6:53 p.m. PDT Sept 11, 1997
Mars-Earth distance on arrival day: 158 million mi (254.6 million km)
Change in velocity: 2,176 mph (973 m/sec)
Velocity before burn (with respect to Mars): 11,386 mph (5.09 km/sec))
Velocity after burn (with respect to Mars): 9,842 mph (4.40 km/sec)
Average deceleration due to burn: 7/100ths of 1 Earth G
Martian seasons at arrival: Fall in northern hemisphere, spring in south

Aerobraking and Mapping Mission

Period of aerobraking: Begins September 17, 1997; continues for 4 months
Period of initial elliptical orbit: 45 hours, plus or minus 3 hours
Final mapping orbit: period 117 min, mean altitude 234 mi (378 km), polar, sun-synchronous
Primary mapping mission: March 15, 1998 to January 31, 2000; covers 1 Martian year (687 Earth days)
Martian seasons when mapping begins: Winter in northern hemisphere, summer in south

Program

Development time: 26 months
Costs: $148 million pre-launch development; $52.6 million launch; $46.4 million mission ops
Spacecraft industrial partner: Lockheed Martin Astronautics, Denver, CO

Mars at a Glance

General

- ❑ One of 5 planets known to ancients; Mars was Roman god of war, agriculture and the state
- ❑ Reddish color; at times the 3rd brightest object in night sky after the Moon and Venus

Physical Characteristics

- ❑ Average diameter 4,219 miles (6,794 kilometers); about half the size of Earth, but twice the size of Earth's Moon
- ❑ Mass 1/10th of Earth's; gravity only 38 percent as strong as Earth's
- ❑ Density 3.9 times greater than water (compared to Earth's 5.5 times greater than water)
- ❑ No magnetic field detected to date

Orbit

- ❑ Fourth planet from the Sun, the next beyond Earth
- ❑ About 1.5 times farther from the Sun than Earth is
- ❑ Orbit elliptical; distance from Sun varies from a minimum of 128.4 million miles (206.7 million kilometers) to a maximum of 154.8 million miles (249.2 million kilometers); average distance from Sun, 141.5 million miles (227.7 million kilometers)
- ❑ Revolves around Sun once every 687 Earth days
- ❑ Rotation period (length of day in Earth days) 24 hours, 37 min, 23 sec (1.026 Earth days)
- ❑ Poles tilted 25 degrees, creating seasons similar to Earth's

Environment

- ❑ Atmosphere composed chiefly of carbon dioxide (95.3%), nitrogen (2.7%) and argon (1.6%)
- ❑ Surface atmospheric pressure 8 millibars (less than 1/100th that of Earth's average)
- ❑ Surface temperature averages -64 F (-53 C); varies from -199 F (-128 C) during polar night to 80 F (27 C) at equator during midday at closest point in orbit to Sun

Features

- ❑ Highest point is Olympus Mons, a huge shield volcano more than 52,000 feet (15,900 meters) high and 370 miles (600 kilometers) across; has about the same area as Arizona
- ❑ Canyon system of Valles Marineris is largest and deepest known in solar system; extends more than 2,500 miles (4,000 kilometers) and has 3 to 6 miles (5 to 10 kilometers) relief from floors to tops of surrounding plateaus
- ❑ "Canals" observed by Giovanni Schiaparelli and Percival Lowell about 100 years ago were a visual illusion in which dark areas appeared connected by lines. The Viking missions of the 1970s, however, established that Mars has channels probably cut by ancient rivers

Moons

- ❑ Two irregularly shaped moons, each only a few kilometers wide
- ❑ Larger moon named Phobos ("fear"); smaller is Deimos ("terror"), named for attributes personified in Greek mythology as sons of the god of war

Historical Mars Missions

Mission, Country, Launch Date, Purpose, Results

Mars 1, USSR, 11/1/62, Mars flyby, lost at 65.9 million miles (106 million kilometers)
Mariner 3, U.S., 11/5/64, Mars flyby, shroud failed
Mariner 4, U.S. 11/28/64, first successful Mars flyby 7/14/65, returned 21 photos
Zond 2, USSR, 11/30/64, Mars flyby, failed to return planetary data
Mariner 6, U.S., 2/24/69, Mars flyby 7/31/69, returned 75 photos
Mariner 7, U.S., 3/27/69, Mars flyby 8/5/69, returned 126 photos
Mariner 8, U.S., 5/8/71, Mars flyby, failed during launch
Mars 2, USSR, 5/19/71, Mars orbiter/lander arrived 11/27/71, no useful data returned
Mars 3, USSR, 5/28/71, Mars orbiter/lander, arrived 12/3/71, some data and few photos
Mariner 9, U.S., 5/30/71, Mars orbiter, in orbit 11/13/71 to 10/27/72, returned 7,329 photos
Mars 4, USSR, 7/21/73, failed Mars orbiter, flew past Mars 2/10/74
Mars 5, USSR, 7/25/73, Mars orbiter, arrived 2/12/74, some data
Mars 6, USSR, 8/5/73, Mars orbiter/lander, arrived 3/12/74, little data return
Mars 7, USSR, 8/9/73, Mars orbiter/lander, arrived 3/9/74, little data return
Viking 1, U.S., 8/20/75, Mars orbiter/lander, orbit 6/19/76-1980, lander 7/20/76-1982
Viking 2, U.S., 9/9/75, Mars orbiter/lander, orbit 8/7/76-1987, lander 9/3/76-1980; combined, the Viking orbiters and landers returned 50,000+ photos
Phobos 1, USSR, 7/7/88, Mars/Phobos orbiter/lander, lost 8/88 en route to Mars
Phobos 2, USSR, 7/12/88, Mars/Phobos orbiter/lander, lost 3/89 near Phobos
Mars Observer, U.S., 9/25/92, orbiter, lost just before Mars arrival 8/22/93 (8/21/93 EDT)
Mars Global Surveyor, 11/7/96, orbiter, en route to orbit insertion 9/12/97 (9/11/97 EDT)
Mars 96, Russia, 11/16/96, orbiter and landers, failed during launch
Mars Pathfinder, U.S., 12/4/96, landed 7/4/97, lander and rover, fulfilled all science objectives

Why Mars?

Of all the planets in the solar system, Mars is the most like Earth and the planet most likely to support eventual human expeditions. Earth's Moon and Mercury are dry, airless bodies. Venus has suffered a runaway greenhouse effect, developing a very dense carbon dioxide atmosphere that has resulted in the escape of all of its water and the rise of torrid, inhospitable surface temperatures of about 900 F (nearly 500 C). Mars, on the other hand, has all of the ingredients necessary for life, including an atmosphere, polar caps and large amounts of water locked beneath its surface. Mars, in fact, is the only other terrestrial planet thought to have abundant water that could be mined and converted into its liquid form to support human life.

Compared to Earth, Mars is about 4,200 miles (6,800 kilometers) in diameter, about half the diameter and about one-eighth the volume of Earth. Mars turns on its axis once every 24 hours, 37 minutes, making a Martian day — called a "sol" — only slightly longer than an Earth day. The planet's poles are tilted to the plane of its orbit at an angle of 25 degrees — about the same amount as Earth, whose poles are titled at 23.3 degrees to the ecliptic plane. Because of its tilted axis, Mars has Earth-like seasonal changes and a wide variety of weather phenomena. Although its atmosphere is tenuous, winds and clouds as high as about 15 miles (25 kilometers) above the surface can blow across stark Martian deserts. Low-level fogs and surface frost have been observed by spacecraft. Spacecraft and ground-based observations have revealed huge dust storms that often start in the southern regions and can spread across the entire planet.

Early Mars may have been like early Earth. Current theories suggest that, early in its history, Mars may have once been much warmer, wetter and enveloped in a much thicker atmosphere. On Earth, evidence for life can be found in some of the oldest rocks, dating from the end of Earth's heavy bombardment by comets and meteors around 4 billion years ago. Surfaces on Mars that are about the same age show remains of ancient lakes, which suggests that liquid water flowed on the surface at one time and the climate was both wetter and substantially warmer. If this proves to be true, then further exploration may reveal whether life did develop on Mars at some point early in its history. If it did not, scientists will want to know why it didn't. Or perhaps they will be able to determine whether life that began early on in Mars' evolution could still survive in some specialized niches such as hydrothermal systems near volcanoes.

Mars is the most accessible planet on which to begin answering fundamental questions about the origin of life. Scientists want to know if we are alone in the universe. Is life a cosmic accident, or does it develop anywhere given the proper environmental conditions? What happened to liquid water on Mars? Could life have begun on Mars and been transported to Earth?

Exploring Mars also will provide us with a better understanding of significant events that humankind may face in the future as Earth continues to evolve. What are the factors involved in natural changes in a planet's climate, for instance? On Earth, one of the most important questions now being studied is whether or not human activities are contributing to possible global warming. Could these climate changes bring about negative environmental changes such as sea level rise due to the melting of the ice caps? Mars provides a natural laboratory for studying climate changes on a variety of time scales. If Mars in the past was warmer and wetter, and had a thicker atmosphere, why did it change?

Layered deposits near the Martian polar caps suggest climatic fluctuations on a shorter time scale. If scientists can learn about the important factors controlling climatic changes on another planet, they may be able to understand the consequences of natural and human-induced changes on Earth.

Mars is an excellent laboratory to engage in such a study. Earth and Venus are active environments, constantly erasing all traces of their evolution with dynamic geological processes. On Mercury and on Earth's Moon, only relatively undisturbed ancient rocks are present. Mars, by contrast, has experienced an intermediate level of geological activity, which has produced rocks on the surface that preserve the entire history of the solar system. Sedimentary rocks preserved on the surface contain a record of the environmental conditions in which they formed and, consequently, any climate changes that have occurred through time.

The Search for Life

After years of exhaustive study of the data returned by the Viking spacecraft from their biology experiments, most scientists concluded that it is unlikely that any life currently exists on the surface of Mars. Centuries of fascination about the possibility of intelligent life on the red planet seemed to fade.

Since that time more than 20 years ago, however, much has been learned about the origins of life on Earth. Biologists learned that the most primitive single-celled microscopic organisms had sprung from hot volcanic vents at the very bottom of Earth's oceans. They found that the most fundamental carbonaceous organic material appear to demonstrate cell division and differentiated cell types, very similar to other fossils and living species. Geologists learned that these organisms could exist in regions along the floors of oceans in environments akin to pressure-cookers, at extremely hot temperatures devoid of light and prone to extreme pressures that no human being could survive. With new technologies and sophisticated instruments, they began to measure the skeletons of bacteria-like organisms lodged deep within old rocks.

Then, in August 1996, a NASA-funded team of scientists announced its findings of the first fossil evidence thought to be from Mars. The findings re-ignited the age-old question: Are we alone in the universe?

The two-year investigation by a team led by scientists from NASA's Johnson Space Center, Houston, TX, revealed evidence that strongly suggested primitive life may have existed on Mars more than 3.6 billion years ago. Researchers discovered an igneous meteorite in Earth's Antarctica that had been blasted away from the surface of Mars in an impact event; the rock was dated to about 4.5 billion years old, the period when Mars and its terrestrial neighbors were forming. According to scientists on the team, the rock contains fossil evidence of what they believe may have been ancient microorganisms.

The team studied carbonate minerals deposited in the fractures of the approximately 4-pound (2-kilogram), potato-shaped Martian meteorite. They suggested living organisms deposited the carbonate — and some remains of the microscopic organisms may have become fossilized — in a fashion similar to the formation of fossils in limestone on Earth. Then, 16 million years ago, a huge comet or asteroid struck Mars, ejecting a piece of the rock from its subsurface location with enough force to escape the planet. For millions of years, the chunk of rock floated through space. It encountered Earth's atmosphere 13,000 years ago and fell in Antarctica as a meteorite.

In the tiny globs of carbonate, researchers found a number of features that could be interpreted as having been formed by possible past life. Team members from Stanford University detected organic molecules called polycyclic aromatic hydrocarbons (PAHs) concentrated in the vicinity of the carbonate. Researchers from NASA Johnson found iron mineral compounds commonly associated with microscopic organisms and the possible microscopic fossil structures.

Most of the team's findings were made possible only because of very recent technological advances in high-resolution scanning electron microscopy and laser mass spectrometry. Just a few years ago, many of the features that they reported were undetectable. Although past studies of the meteorite in question — designated ALH84001 — and others of Martian origin failed to detect evidence of past life, they were generally performed using lower levels of magnification, without the benefit of the technology used in this research. In addition, the recent suggestion of extremely small bacteria on Earth, called nanobacteria, prompted the team to perform this work at a much finer scale than had been done in the past.

The findings, presented in the August 16, 1996, issue of the journal Science, have been put forth to the scientific community at large for further study. The team was co-led by Johnson Space Center planetary scientists Dr. David McKay, Dr. Everett Gibson and Kathie Thomas-Keprta of Lockheed Martin, with the major collaboration of a Stanford University team headed by chemistry professor Dr. Richard Zare, as well as six other NASA and university partners. A variety of papers have been published in the months since that announcement that have argued for and against the claims that the evidence is suggestive of ancient life.

Whether or not the evidence stands up to scientific scrutiny, the suggestion alone has renewed interest in exploring the planets, stars and galaxies outside of the Milky Way galaxy. The questions resound: Does life exist elsewhere in the universe? And why does it exist at all? Did life as we know it originate on Earth or did it spring from other planets, only to be transported to Earth, where it found the most advantageous niche for continuing evolution?

In the year 2005, NASA plans to send to Mars a sample return mission, a robotic spacecraft that will be able to return soil and rock samples to Earth for direct study much as the Apollo astronauts returned hundreds of pounds of lunar rocks to Earth. Additional debate and scientific experimentation with Martian meteorites in the next several years may bring about an answer that could become a turning point in the history of civilization.

The Multi-Year Mars Program

Launch of the two 1996 missions to Mars — Mars Pathfinder and Mars Global Surveyor — ushered in a continuing U.S. campaign of Mars exploration. The program is designed to send low-cost spacecraft to Mars every 26 months well into the next decade.

Although they were launched within a month of each other in late 1996, Mars Global Surveyor and Mars Pathfinder have their roots in two separate NASA programs. Mars Pathfinder was approved as a stand-alone project under NASA's Discovery program, which was created in 1992 to fund low-cost solar system missions. Mars Global Surveyor, on the other hand, is the first in a multi-year series of missions under the Mars Surveyor program.

After 1996, current plans call for two Mars Surveyor spacecraft to be sent to Mars during each launch opportunity in 1998, 2001 and 2003, and a single sample-return spacecraft in 2005. The program is expected to continue beyond 2005 on a direction set by results obtained from earlier flights. In addition to fulfilling specific science goals, these missions are expected to pave the way for human exploration some time early in the next century.

By 2005, NASA will have launched a series of small spacecraft with highly focused science goals probing and watching the planet, setting in place a new way of exploring the solar system. Based on the space agency's philosophy of bringing faster, better and cheaper missions to fruition, combinations of orbiters and landers will take advantage of novel microtechnologies — lasers, microprocessors and electronic circuits, computers and cameras the size of a gaming die — to deliver an ingenious armada of miniaturized robotic payloads to Earth's planetary neighbor.

The current plan for U.S. missions to Mars is listed below. Projected costs are for spacecraft development only and do not include launch vehicles, mission operations after the first 30 days or spacecraft tracking.

1996:

❑ **Mars Pathfinder** (Discovery mission). Demonstrate low cost-entry and landing system, and rover mobility; initiates mineralogy studies; continue study of surface characteristics and Martian weather. Cost: $171 million (capped at $150 million in fiscal year 1992 dollars), plus $25 million for rover.

❑ **Mars Global Surveyor**. Perform global reconnaissance of physical and mineralogical surface characteristics, including evidence of water; determine global topography and geologic structure of Mars; assess atmosphere and magnetic field during seasonal cycles; provide communication relay for the Mars Surveyor '98 microprobes and backup communication relay for the Mars Surveyor '98 lander. Cost: $148 million.

1998:

❑ **Mars Surveyor '98 Orbiter**. Launch scheduled December 10, 1998. Characterize the Martian atmosphere, including definition of atmospheric water content during seasonal cycles. Provide primary communication relay for the Mars Surveyor '98 lander.

❑ **Mars Surveyor '98 Lander**. Launch scheduled January 3, 1999. Access past and present-day water reservoirs on Mars; study surface chemistry, topology and mineralogy; continue weather studies. The spacecraft also will deliver two innovative soil microprobes developed under NASA's New Millennium program. Combined cost of both 1998 missions: $187 million, plus $26 million for the microprobes.

2001:

❑ **Mars Surveyor '01 Orbiter**. Characterize mineralogy and chemistry of surface, including identification of near surface water reservoirs.

❑ **Mars Surveyor '01 Lander and Rover**. Characterize terrain over tens of miles (or kilometers) at site selected from MGS and Mars Surveyor '98 orbital observations. Select and gather samples for possible later return. Characterize dust, soil and radiation conditions as they pertain to eventual human exploration. Test components of in-situ propellant production plant. Combined development cost of both 2001 missions: approximately $250 million.

2003:

❑ **Mars Surveyor '03 Lander and Rover**. Characterize terrain over tens of miles (or kilometers) at a site chosen using earlier orbital observations; select and gather samples for possible later return. Other objectives, related to eventual human exploration, are expected to be added to both 2003 missions.

❑ **Mars Surveyor '03 Orbiter**: Provide communications and navigation facilities for 2003 and later missions on the Martian surface. Combined development cost of both 2003 missions: approximately $220 million.

2005:

❑ **Sample Return Mission**. Return a sample from one of the two rovers launched in 2001 and 2003. Development cost: approximately $400 million.

Beyond 2005:

❑ To be determined. Plans will depend on results of earlier missions.

International Cooperation

International collaboration on all Mars missions will be an important aspect of exploration in the next decade. Many space agencies around the world are considering participation in the planning stages of future missions, including those of Russia, Japan and many European countries. Scientists from the United States are consulting with international partners on the best ways to combine their efforts in Mars exploration. This may result in new proposals for cooperative missions in the first decade of the 21st century.

Among the ongoing programs taking shape is one called "Mars Together," a concept for the joint exploration of Mars by Russia and the United States. The program was initiated in the spring of 1994 and bore its first fruit in the summer of 1995. A Russian co-principal investigator and Russian hardware were incorporated into one experiment, the pressure modulator infrared radiometer, to be flown on NASA's Mars Surveyor 1998 orbiter. Dr. Vassili Moroz of the Russian Academy of Sciences Space Research Institute (IKI) in Moscow will co-lead the experiment with Dr. Daniel McCleese of NASA's Jet Propulsion Laboratory. The Russian institute also will provide the optical bench for the radiometer. In addition, IKI will furnish a complete science instrument, the LIDAR (light detection and ranging) atmospheric sounder, for the 1998 Mars Surveyor lander.

Under Mars Together, NASA is discussing possible collaboration with Russia on a mission in 2001. This possible arrangement involves an additional rover launched and operated by Russia that also would select and gather samples for possible later return. The Mars Surveyor '01 orbiter would provide the communications relay for this rover.

Japan also is building an orbiter, called Planet B, to study the Martian upper atmosphere and its interaction with the solar wind. The spacecraft, to be launched in August 1998, will carry a U.S. neutral mass spectrometer instrument to investigate the upper atmosphere, in addition to a variety of Japanese instruments.

The nations of Europe are considering a mission in 2003 called Mars Express. The tentative plan includes an orbiter carrying one or more small landers and remote-sensing instruments that would study topography and surface minerals. A final decision on this mission is expected before the end of 1998.

Mission Overview

Mars Global Surveyor is a global mapping mission, designed to gather data on the atmosphere, surface and interior of Mars. Global data sets will enable scientists to determine Mars' current state and characterize its evolution. Among a myriad of science objectives, Mars Global Surveyor will study Mars' climate, surface topography and subsurface resources, and map the entire globe. Information from the mission will serve as a foundation for planning future robotic and human missions to Mars.

Launch

Mars Global Surveyor was launched at 12:00:49 p.m. Eastern Standard Time on November 7, 1996, atop a Delta II 7925A launch vehicle from launch pad 17A at Cape Canaveral Air Station, FL. The launch was delayed one day due to clouds and upper level winds on the first day of the launch period.

After liftoff, the first stage of the three-stage Delta rocket and the nine solid-fuel strap-on boosters lifted the spacecraft to an altitude of about 70 miles (115 kilometers) above Earth, and the Delta's second stage then boosted the payload into a circular parking orbit 115 miles (185 kilometers) above Earth. After achieving the parking orbit, the booster and spacecraft coasted for about 35 minutes, then fired to raise the apogee, or high point, of the parking orbit.

Small rockets were used to spin up the Delta's third stage and spacecraft to 60 rpm. The second stage was jettisoned and the third stage, a Star 48B solid rocket, was ignited to complete the trans-Mars injection burn and send Global Surveyor on its way to the red planet.

Solar panel deployment. About an hour after launch, the spacecraft's two 11-foot (3.5-meter) solar arrays were unfolded and a piece of metal called the "damper arm" on one of the panels was broken off during the deployment. (The damper arm is the part of the solar array deployment mechanism at the joint where the entire panel is attached to the spacecraft.) The metal fragment became trapped in the 2-inch (50-millimeter) space between the panel's shoulder joint and the edge of the solar panel, leaving the array about 19 degrees from its fully deployed position.

The damper arm connects the panel to a device called the "rate damper," which functions in much the same way as the hydraulic closer on a screen door acts to slow the speed at which the door closes. In Global Surveyor's case, the rate damper was used to slow the motion of the solar panel as it unfolded from its stowed position.

The operations team studied the problem with engineering data and computer-simulated models over the next two weeks. Two strategies for correcting the problem emerged. The first involved performing several slight maneuvers using the spacecraft's electrically driven solar array positioning actuators to try to gently shake the array and free the trapped debris. These maneuvers were carried out in January and February 1997, to no avail.

The second strategy was to reconfigure the solar panel during aerobraking so that the unlatched side of the panel would not be facing into the direction of the air flow and at risk of folding up on itself. The solar arrays are essential to the aerobraking technique and will be used to provide the drag surface that will slow the spacecraft's orbital speed, transforming its initial elliptical orbit into the final, circular mapping orbit. The technique allows Global Surveyor to carry considerably less fuel to Mars and take advantage of the planet's atmospheric drag to lower itself into the correct orbit.

After testing and analysis, the flight team determined that aerobraking could be safely accomplished by rotating the panel 180 degrees, turning the panel's solar-cell side into the flow of wind each time the spacecraft dips into the Martian atmosphere. By turning the panel's solar-cell side into the direction of the air flow, force will be exerted on the debris that is lodged in the hinge. The force of the air flow on the opposite side of the panel will insure the panel does not close up, and may possibly exert enough force to snap the panel into the latched position.

Cruise

The spacecraft spent 309 days en route to Mars, following what navigators call a Type 2 trajectory. This type of flight path took the spacecraft more than 180 degrees around the Sun and, compared with other types of trajectories, is a slower way to reach Mars. Because the spacecraft has been traveling at a slower velocity, however, it will require less propellant to slow down once it is ready to be captured in orbit around the destination planet.

On the first part of its flight, all spacecraft communications with Earth occurred through Global Surveyor's broad-beam, low-gain antenna. The dish-shaped, narrow-beam high-gain antenna sat on the spacecraft in a stowed, body-fixed orientation during cruise, making communications with Earth through the high-gain antenna impossible unless the spacecraft was turned to point the high-gain antenna directly at Earth.

Outer cruise began on January 9, 1997, when the spacecraft switched from the low-gain to the high-gain antenna for communications with Earth. The switch-over became feasible when the angle between the Sun and Earth as seen from the spacecraft fell to a level low enough to allow the solar panels to collect adequate power while pointing the antenna at Earth.

Three trajectory correction maneuvers were performed along the trip to Mars to fine-tune the spacecraft's flight path. These thruster firings were performed on November 21, 1996, March 20, 1997, and August 25, 1997. Another maneuver had been scheduled for April 21, 1997, but was not necessary and, hence, not performed.

During the last 30 days of approach to Mars, the flight team focused on final targeting of the spacecraft to the proper aim point, and preparations for orbit insertion. On August 19 and 20, the spacecraft's camera took a series of eight images of Mars, at a distance of 3.4 million miles (5.5 million kilometers). With a resolution of about 12.5 miles (20 kilometers) per picture element, these images were processed to create a movie of the planet as it rotated.

Mars Orbit Insertion

Mars Global Surveyor will perform an attitude reorientation maneuver once it reaches the orbit of Mars to turn the spacecraft's main engine toward the direction of its motion, or toward Mars. Then the spacecraft will fire its 660-newton main engine for approximately 22 minutes, 17 seconds, to slow down. The burn will begin at 01:17:16 and conclude at 01:39:33 Universal Time (UT) September 12, 1997 (6:17 to 6:39 p.m. September 11, 1997 Pacific Daylight Time (PDT)). Because it takes 14 minutes, 6 seconds for radio signals to travel from Mars to Earth on arrival day, the beginning and end of the burn will be detected on Earth at 6:31 and 6:53 p.m. PDT, respectively.

Telecommunications with the spacecraft will cease 9 minutes into the burn as Mars Global Surveyor passes behind Mars as seen from Earth. This occultation will last 14 minutes. NASA's Deep Space Network tracking facilities in California and Australia will regain communications with Global Surveyor at 01:57:00 UT (6:57 p.m. PDT), when the spacecraft reemerges from behind Mars.

By completion of the burn, the spacecraft will have slowed down by about 2,183 miles per hour (976 meters per second) with respect to Mars. Global Surveyor will be in a highly elliptical orbit, completing one revolution around Mars every 45 hours, plus or minus 3 hours.

Aerobraking

Selection of the less expensive Delta II booster in order to stay within program costs placed mass limitations on Mars Global Surveyor and prevented it from carrying enough propellant to Mars to directly achieve a low-altitude mapping orbit. An innovative, mission-enabling braking technique known as aerobraking was chosen instead to trim the spacecraft's initial, highly elliptical capture orbit and lower it to a nearly circular mapping orbit.

The Magellan spacecraft at Venus was the first planetary spacecraft to try aerobraking, as a demonstration, in the summer of 1993. The success of this demonstration cleared the way for its implementation in the Mars Global Surveyor mission design.

Global Surveyor's use of aerobraking will differ from that performed with the Magellan spacecraft in two important ways. First, Global Surveyor must aerobrake before it can start its primary mapping mission, whereas Magellan tested aerobraking as an engineering demonstration at the conclusion of its mission. Consequently, Global Surveyor's mission objectives are dependent on successfully aerobraking through the Martian atmosphere until the proper mapping orbit is achieved. Not only must aerobraking be successful, but it must be accomplished so that the spacecraft crosses the equator within a few minutes of 2 p.m. local solar time each orbit. This is called a "sun-synchronous" orbit. These two elements of the aerobraking phase make the Mars Global Surveyor's navigation by far the most challenging of the planetary missions to date.

Mars Global Surveyor
Orbit Insertion Timeline

Thursday, September 11, 1997
All times are Earth-received, Pacific Daylight Time

12:40 p.m.	Deep Space Station 14 at Goldstone, CA, begins tracking
12:40	Deep Space Station 15 at Goldstone, CA, begins tracking
4:31	Gyro #2 turned on
4:35	Deep Space Station 43 in Australia begins tracking
4:35	Deep Space Station 45 in Australia begins tracking
5:01	Spacecraft begins loading maneuver control parameters
5:17	Deep Space Station 15 transmitter off
5:31	Spacecraft begins maneuver command block
5:55	Spacecraft transmitter switches from high-gain antenna to low-gain antenna #1
5:55	Spacecraft's telemetry turned off; transmits only carrier signal
~5:59	Deep Space Stations re-acquire signal
6:01	Thrusters enabled for steering and attitude control during orbit insertion
6:14	Spacecraft starts turn to align rocket engine in burn direction
6:15	Solar arrays begin turning to orbit insertion orientation
6:29	Inertia measurement unit set to supply accelerometer data
6:30	Fuel and oxidizer valves enabled and armed
6:31	Main engine burn begins
6:40	Deep Space Station 45 transmitter on
6:43	Spacecraft passes behind Mars; radio signal lost
6:44	Closest approach to Mars (periapsis #1)
6:53	Main engine burn ends
6:55	Attitude control returned to reaction wheels
6:55	Spacecraft turns to Earth point and resumes array-normal-spin attitude
6:56	Solar arrays moved to array-normal-spin position
6:57	Spacecraft emerges from behind Mars
~6:57 - 7:03	Deep Space Stations acquire spacecraft carrier signal
7:10	Spacecraft transmitter switches from low-gain antenna to high-gain antenna
7:10	Spacecraft resumes transmitting telemetry (data)

During each of its orbits shortly after Mars arrival, the spacecraft will pass through the upper fringes of the Martian atmosphere each time it reaches periapsis, the point in its orbit closest to the planet. Friction from the atmosphere will cause the spacecraft to slow slightly and lose some of its momentum during each orbit. Loss of momentum will lower the spacecraft's apoapsis, or the point in its orbit farthest from Mars.

Aerobraking will take place over four months, beginning with an initial "walk-in" phase. After the spacecraft is captured in a 45-hour (plus or minus 3 hours) elliptical orbit around Mars, its apoapsis and periapsis will be gradually adjusted as scientists and engineers learn more about the density of Mars' upper atmosphere. The flight team will be able to gauge atmospheric density and variations from one orbit to another, while the spacecraft is tracked continuously by the 112-foot-diameter (34-meter) antennas of NASA's Deep Space Network, which are designed to both transmit and receive X-band signals.

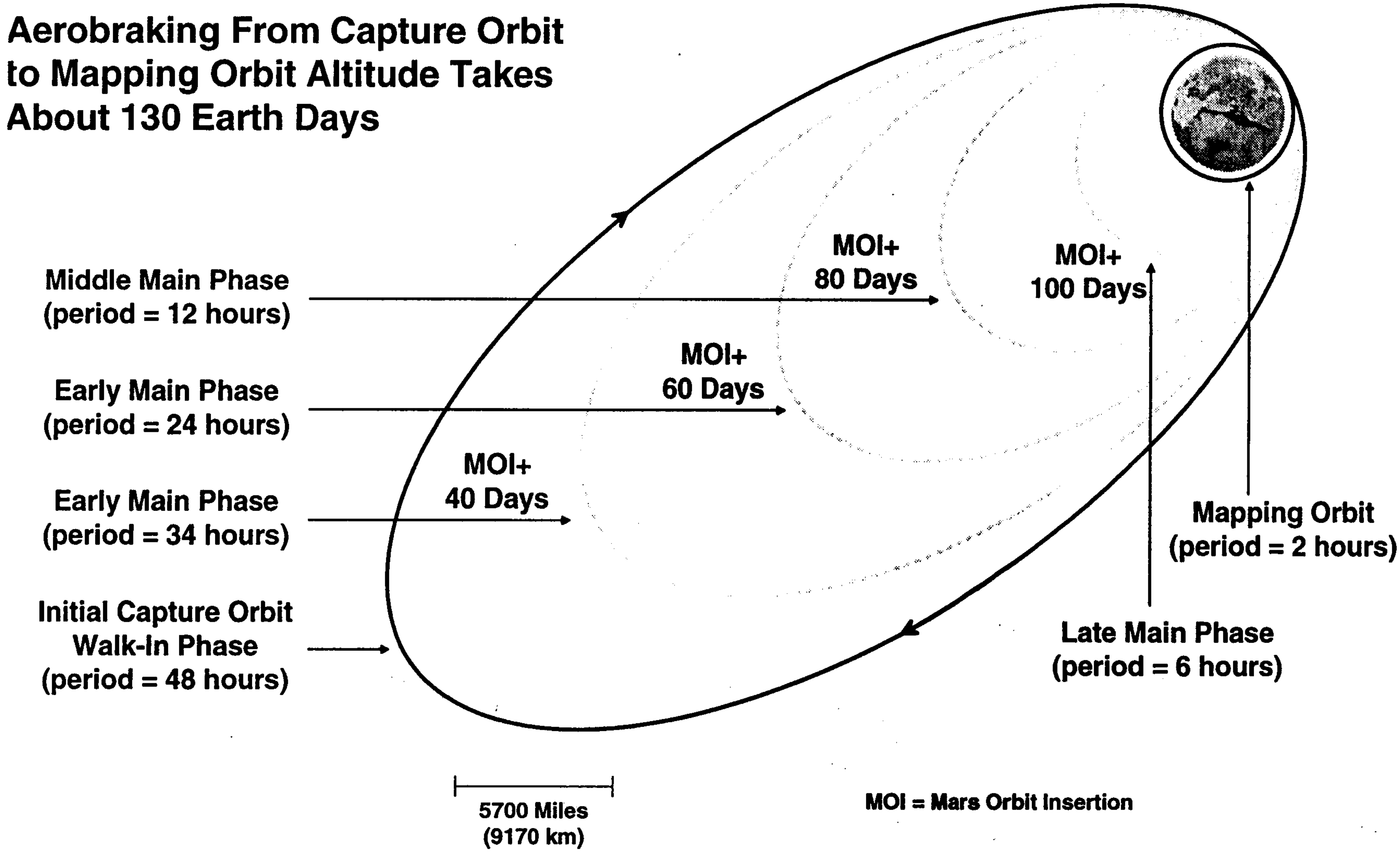
In the initial walk-in phase, the spacecraft's closest pass over Mars will be lowered from the capture orbit of 156 miles (250 kilometers) above the surface to about 69 miles (112 kilometers) above the surface. This will be done with a series of five propulsive maneuvers, using the spacecraft's thrusters. The first of these propulsive burns, scheduled to take place on September 16, will be the largest and drop the spacecraft's periapsis altitude to 93 miles (150 kilometers). The next four burns, occurring on September 18, 20, 22 and 24, will lower the spacecraft gradually to the 69-mile (112-kilometer) aerobraking altitude.

After completion of the walk-in phase, the spacecraft will spend about three months in the main phase of aerobraking. During this time, Global Surveyor's apoapsis altitude of 33,480 miles (54,000 kilometers) will be dropped to about 1,240 miles (2,000 kilometers). As the spacecraft's orbit is trimmed, the time it takes to make one complete revolution around Mars will drop to less than three hours.

The final three weeks of aerobraking constitute the "walk-out" phase and will reduce the spacecraft's apoapsis to 279 miles (450 kilometers) above the surface of Mars. As Global Surveyor lowers its apoapsis, it will also use its thrusters to gradually raise its periapsis from 69 miles (112 kilometers) to 89 miles (143 kilometers) above the surface. By doing so, the spacecraft will be slowly "walking out" of the atmosphere during each closest approach to Mars. Adjustments in both the farthest and closest points in Mars Global Surveyor's orbit around the planet will be reshaping its flight path from highly elliptical to a nearly circular orbit.

Aerobraking will end with a termination burn performed on about January 18, 1998. This burn will raise Global Surveyor's periapsis one final time, from 89 miles (143 kilometers) to approximately 279 miles (450 kilometers) above the surface of Mars. The spacecraft will then be circling Mars in a 248- by 279-mile (400-kilometer by 450-kilometer) orbit, just slightly off from its final mapping orbit. By then Global Surveyor will be orbiting Mars about once every 118 minutes, and crossing Mars' equator at just about 2 p.m. local solar time each orbit.

Mars Global Surveyor will begin aerobraking in the southern spring, and the historical



Mars Global Surveyor aerobraking orbits record of global dust storms suggests that this is the most likely season for such storms to occur. During these storms, the dust itself is not of concern, since there is no evidence that it reaches anywhere near the altitudes at which aerobraking will occur. Scientists are more concerned with the possible increase in atmospheric density at the aerobraking altitude that could be caused by increased heating due to a dustier atmosphere in general.

Data from the highly successful Mars Pathfinder mission provided valuable new information about the density of the Martian atmosphere all the way up to about 75 miles (120 kilometers), which will be used to update the atmospheric models before the start of the Mars Global Surveyor aerobraking phase. Pathfinder also recorded dust activity and pressure and temperature fluctuations during its primary mission in July 1997. If Pathfinder's lander and rover are still operating by the time Mars Global Surveyor arrives at Mars, surface temperature, pressure and opacity measurements will be monitored to help the Global Surveyor navigation team adjust the spacecraft's orbit.

Several measurements will also be made from the Hubble Space Telescope and from Earth. Hubble will take multiple images of Mars near the start of the aerobraking phase, before Mars gets too close to the Sun as viewed from Earth. Hubble images taken during the week before Pathfinder landed showed local dust activity near the landing site in Ares Vallis. When combined with Earth-based observations made at the Space Science Institute in Boulder, CO, using the National Radio Astronomy Observatory microwave antenna, these measurements will yield a global average atmospheric temperature profile from the ground to about 35 miles (60 kilometers) above the surface.

Scientists have been able to infer that moisture in the atmosphere usually confines Martian dust to lower altitudes, where it has a minimal impact on the densities at higher altitudes. As Mars gets closer to the Sun, atmospheric temperatures rise, along with water vapor content, and allow dust to circulate at higher altitudes. The Hubble and radio astronomy microwave observations will be used to keep a close eye on the Martian atmosphere during aerobraking, not only because the spacecraft's periapsis will have to be raised to survive the effects of a global dust storm, but also because the aerobraking phase coincides with the first half of the dust storm season.

Mars Global Surveyor will also be dipping repeatedly into the Martian atmosphere in a different configuration than was originally planned. Because one of the spacecraft's two solar panels did not fully deploy and latch into place after launch, it is tilted at about 20 degrees from its fully deployed position. After careful analysis, engineers determined that the only risk posed by the tilted panel was the possibility that the panel might fold up on itself if enough wind flow was exerted.

To minimize that risk, the operations team will rotate the unlatched panel 180 degrees each time the spacecraft encounters the strongest air flow, which will be at periapsis. By rotating the panel and turning its solar-cell side into the direction of the air flow, the latch will not be in danger of folding up. The air flow, when exerted on the opposite side of the latch, may, in fact, push the array into the fully locked position. Whether or not that is accomplished, Global

Surveyor's new aerobraking configuration does not pose significant risk to the science objectives of the mission.

Science During Aerobraking

Early science measurements conducted during aerobraking will provide the navigation team with enough information to perform alternative aerobraking strategies should the situation arise. Scientists will benefit from new observations of Mars achieved with unique lighting geometry from Global Surveyor's aerobraking orbit. The spacecraft's low-altitude passes will allow scientists to record information from much closer to the planet than will be possible during the mapping period. This 4-1/2-month transition will also give experiment teams time to calibrate their instruments and prepare for continuous mapping operations.

The Mars orbital camera will image the surface of Mars at low Sun elevations between 15 degrees north latitude and 45 degrees south latitude, as the spacecraft slowly unwinds from the aerobraking attitude. Image swaths taken over 100 orbital revolutions will yield more than 5,000 pictures at five times the surface resolution of Viking orbiter imaging.

Data from the thermal emission spectrometer will include 100 atmospheric profiles of temperature and dust content at an unprecedented altitude of about 60 miles (100 kilometers). This will be followed each orbit by mid-latitude infrared measurements with a resolution of 19 to 25 miles (30 to 40 kilometers). In addition, daily global coverage of thermal and compositional properties will be recorded at a resolution of about 185 to 250 miles (300 to 400 kilometers) resolution, in association with unique local times of day and seasons.

As the elliptical orbit shrinks, the magnetometer will complete its primary science objective of determining the existence of a global magnetic field and measuring solar wind interaction with Mars' magnetopause, the boundary beyond which Mars no longer influences space. The electron reflectometer portion of this experiment will observe electron density variations in the ionosphere at the lowest altitude during its two months of operation.

Pointing down at the planet, the laser altimeter will have a unique opportunity during the spacecraft's closest approach to the planet on its third orbit after arrival to obtain a 373-mile (600-kilometer) swath, centered at 30 degrees north latitude, with 655 feet (200 meters) of spatial resolution and 6.5 feet (2 meters) of altitude precision. This orbit also permits the only forward/aft viewing by the thermal emission spectrometer prior to mapping the planet at 5:30 p.m. local solar time.

Finally, as the spacecraft's orbit is adjusted to achieve a periapsis of 124 miles (200 kilometers) from the surface, the radio science team will see a fourfold improvement in the sensitivity of their measurements when Global Surveyor flies over features known to produce gravity variations, such as the south polar cap.

The Mapping Mission

The final mapping orbit will be nearly circular, at 217 by 254 miles (350 by 410 kilometers), or an average of 234 miles (378 kilometers) above the planet's surface.

After the mapping orbit is achieved, spacecraft systems will be deployed and instruments will be checked out over the next 10 days.

The primary mission begins once the spacecraft has reached its mapping orbit and is completing one orbit around Mars about every two hours. Each new orbit will bring the spacecraft over a different part of Mars. As the weeks pass, the spacecraft will create a global portrait of Mars — capturing the planet's ancient cratered plains, huge canyon system, massive volcanoes, channels and frozen polar caps. During its mission, Mars Global Surveyor will pass over the terrain where the two U.S. Viking landers — separated by more than 4,000 miles (6,400 kilometers) — have rested for 21 years, and over Ares Vallis, home of the Mars Pathfinder lander (or Carl Sagan Memorial Station) and the Sojourner rover.

The primary mapping mission will begin on March 15, 1998, and last until January 31, 2000 — a period of one Martian year or 687 Earth days (almost two Earth years). The spacecraft will transmit its recorded data back to Earth once a day during a single 10-hour tracking pass by antennas of the Deep Space Network. During mapping operations, the spacecraft will return more than 700 billion bits of scientific data to Earth — more than that returned by all previous missions to Mars and, in fact, roughly equal to the total amount of data returned by all planetary missions since the beginning of planetary exploration with the exception of the Magellan mission to Venus.

As Mars rotates beneath the spacecraft, a suite of onboard instruments will record a variety of detailed information. Detectors will measure radiation — visible and infrared — from the surface to deduce the presence of minerals that make up Mars. These same instruments will record infrared radiation from the thin Martian atmosphere, gathering data about its changing pressure, composition, water content and dust clouds. By firing short pulses of laser light at the surface and measuring the time the reflections take to return, a laser altimeter will map out the heights of Mars' mountains and the depths of its valleys.

The camera system will use wide- and narrow-angle lenses to record land forms and atmospheric cloud patterns. Another sensor will look for a Martian magnetic field. As the telecommunications subsystem transmits information back to Earth, engineers will use the signal of the orbiting spacecraft to derive data about the planet's atmosphere and gravitational field.

By the time global mapping operations are over, Mars Global Surveyor will have obtained an extensive record of the nature and behavior of the Martian surface, atmosphere and interior. Such a record will aid in planning more specialized explorations that might involve robots, scientific stations deployed to the Martian surface, sample return missions and perhaps even human landings. Just as importantly, this record will help scientists understand planet

Earth and what the future might have in store for humanity.

Mission Operations

Throughout the two years of Mars Global Surveyor's mapping mission, principal investigators, team leaders and interdisciplinary scientists will have science operations planning computers at their home institutions. All will be electronically connected to the project database at the Jet Propulsion Laboratory in Pasadena, CA, giving them direct involvement in mission operations.

Their computers will be equipped with software that allows the science teams to remotely initiate most of the commands required by their instruments to conduct desired experiments. The teams will be able to access raw science data within hours of their receipt on Earth. This automated operation will provide "quick-look" science data and let investigators easily monitor the health and performance of their instruments.

Many images and other data will be immediately available to the public on the Internet. After a short period of data validation, science data, both raw and processed, along with supplementary processing information and documentation, will be transferred to NASA's Planetary Data System archive for access and use by the broader planetary science community and the general public.

Control and operation of Mars Global Surveyor will be performed by a team of engineers located at JPL and at Lockheed Martin Astronautics Inc. in Denver, CO. Engineers in Denver will be electronically linked to JPL, providing monitoring and analysis of Mars Global Surveyor based on telemetry received from the spacecraft through NASA's Deep Space Network. The team will also develop the sequence of commands that will be sent to the spacecraft via the Deep Space Network. The electronic networking eliminates the costs of relocating mission operations team members during the mission.

The Spacecraft

The main component of the Mars Global Surveyor spacecraft is a rectangular body, or bus, that houses computers, the radio system, solid-state data recorders, fuel tanks and other equipment. Attached to the outside of the bus are several rocket thrusters, which are fired to adjust the spacecraft's path during the cruise to Mars and to modify the spacecraft's orbit around the planet.

At launch, the spacecraft weighed 2,337 pounds (1,060 kilograms), including the science payload and fuel, and stands about 10 feet (3 meters) tall. The bus or main body of the spacecraft measures 4 by 4 feet (1.2 by 1.2 meters) and is 40 feet (12 meters) across from tip to tip when the solar panels are fully unfolded. The high-gain antenna, deployed in the cruise phase, measures 5 feet (1.5 meters) in diameter. The high-gain antenna will be deployed on a 6-1/2-foot-long (2-meter) boom.

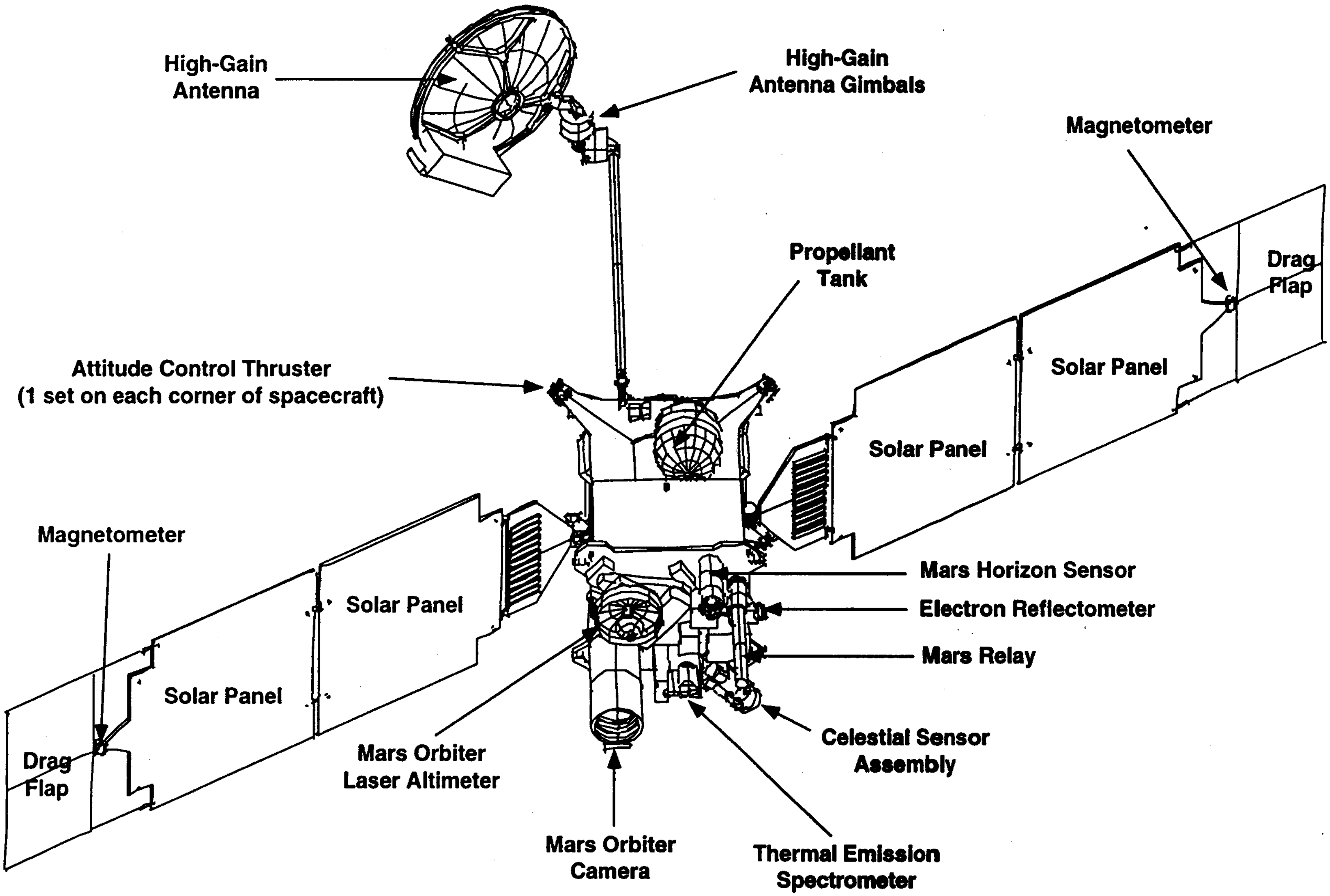
To minimize costs, spare units left over from the Mars Observer mission were used in portions of the spacecraft's electronics and for some of the science instruments. The spacecraft design also incorporates new hardware — the radio transmitters, solid state recorders, propulsion system and composite material bus structure.

Mars Global Surveyor will orbit the planet so that one side of the bus, called the nadir deck, always faces the Martian surface. Of the six science instruments, four — the Mars orbiter camera, the Mars orbiter laser altimeter, the electron reflectometer and the thermal emission spectrometer — are attached to the nadir deck, along with the Mars relay radio system. The magnetometer sensors are mounted on the ends of the solar arrays.

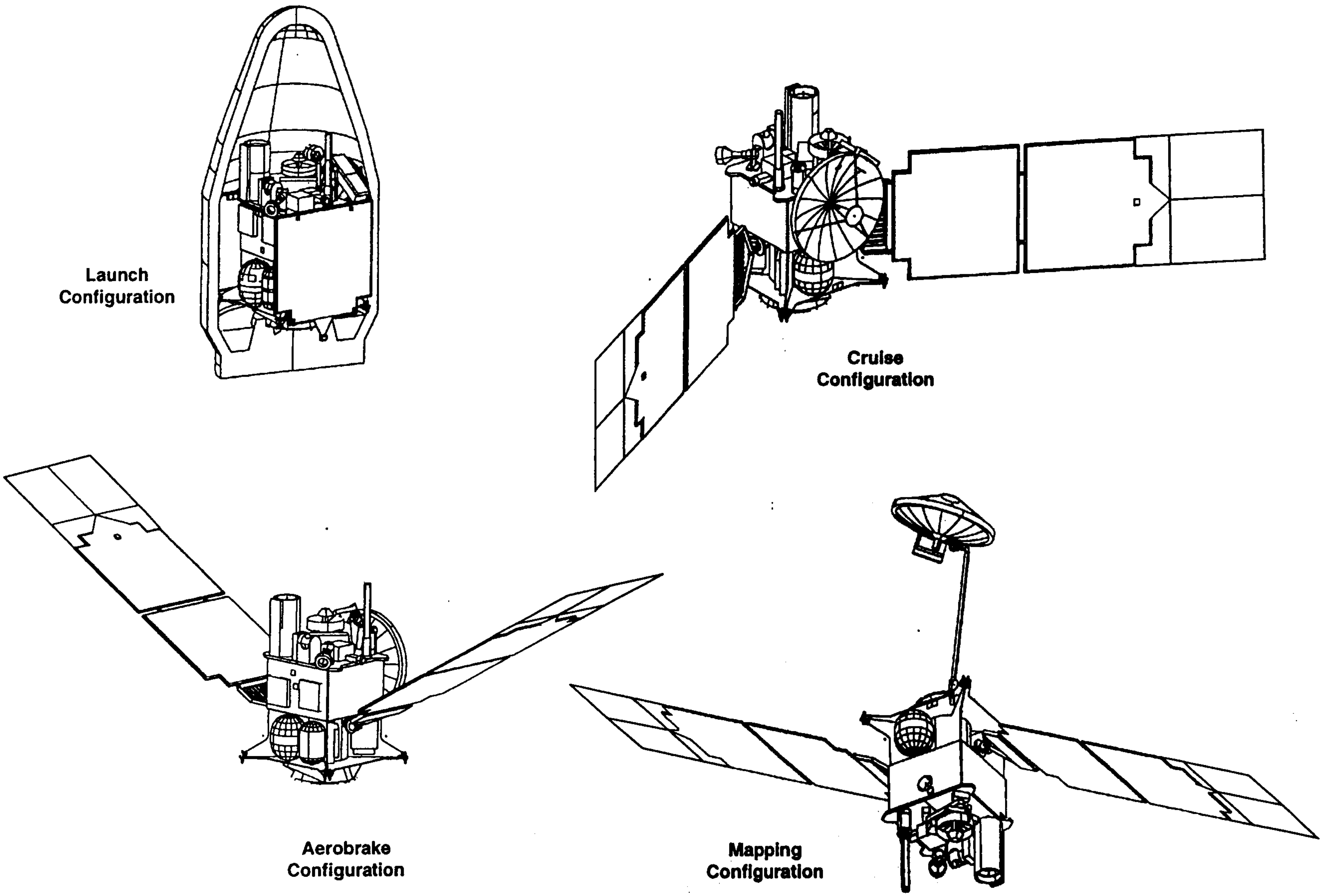
The bus has two solar-array wings and a boom-mounted high-gain communications antenna. The solar arrays, which always point toward the Sun, provide 980 watts of electricity for operating the spacecraft's electronic equipment and for charging nickel hydrogen batteries. The batteries will provide electricity when the spacecraft is mapping the dark side of Mars. To maintain appropriate operating temperatures, most of the outer exposed parts of the spacecraft, including the science instruments, are wrapped in thermal blankets.

In its mapping configuration, the dish-shaped high-gain antenna is deployed on the end of a 6-1/2-foot (2-meter) boom so that its view of Earth will not be blocked by the solar arrays as the spacecraft orbits Mars. Measuring 5 feet (1.5 meters) in diameter, this steerable antenna will be pointed toward Earth even though the spacecraft's position will be continuously adjusted during mapping to keep the nadir deck pointed toward Mars. The spacecraft's radio system, including the high-gain antenna, also will function as a science instrument. Researchers will use it in conjunction with NASA's Deep Space Network ground stations for the radio science investigations.

Spacecraft communications with Earth will always utilize X-band frequencies for radio tracking, return of science and engineering telemetry, commanding and the radio science experi-



Mars Global Surveyor spacecraft



Mars Global Surveyor configurations

ments. However, the spacecraft's telecommunications equipment also accommodates Ka-band downlink, which was furnished as an experiment to demonstrate its feasibility for future missions. Primary communications to and from the spacecraft occur through the 5-foot-diameter (1.5-meter) high-gain antenna.

From launch through the aerobraking operations, the high-gain antenna remains fixed to one side of the spacecraft, and the spacecraft must be slewed to point the antenna directly toward Earth for communications. Just before the start of mapping, the high-gain antenna will be deployed on the end of a 6.5-foot (2-meter) boom mounted to the same side of the spacecraft. This configuration will allow the antenna to automatically track Earth by using two gimbals that hold the antenna to the boom.

In addition to the high-gain antenna, the spacecraft also carries four low-gain antennas that could be used in the event ground-controllers lose the signal from the high-gain antenna. Two of these low-gain antennas function as transmit antennas, while the other two can receive signals from Earth. Placement of these four low-gain antennas insures that the spacecraft can receive commands and transmit downlink telemetry in a wide range of orientations in space.

The spacecraft's 25-watt radio frequency amplifiers allow Global Surveyor to transmit science and engineering telemetry at data rates between 21,333 symbols per second to 85,333 symbols per second. A symbol is specially encoded bit. It takes approximately 1.147 bits of storage space to encode one bit of raw data with this particular encoding scheme.

Data rates for sending commands to the spacecraft will vary from as low as 7.8 bits per second using the low-gain antennas to as high as 500 bits per second using the high-gain antenna. The standard date rate is 125 bits per second. Global Surveyor can receive instructions from Earth at a maximum rate of 12.5 commands per second.

Science Objectives

Mars Global Surveyor is designed to provide a detailed, global map of Mars that will allow scientists to study its geology, climate and interior. Key science objectives are to:

- Characterize the surface features and geological processes on Mars.

- Determine the composition, distribution and physical properties of surface minerals, rocks and ice.

- Determine the global topography, planet shape and gravitational field.

- Establish the nature of the magnetic field and map the crustal remnant field. (A crustal remnant field is evidence of magnetism that is detected within the planet's crust or rocks, produced by the planet's own magnetic field at the time of formation.)

- Monitor global weather and the thermal structure of the atmosphere.

- Study interactions between Mars' surface and the atmosphere by monitoring surface features, polar caps that expand and recede, the polar energy balance, and dust and clouds as they migrate over a seasonal cycle.

Among the questions scientists wish to answer are those relating to Mars' early atmosphere and the dramatic climate changes which sent the planet into a deep freeze. All the ingredients necessary for life exist on Mars, including water, yet the surface of Mars is totally dry and probably devoid of life today.

Water is fundamental to the understanding of geological processes and climate change. But water cannot exist in liquid form at the low atmospheric pressures that currently prevail on the surface of Mars; it turns into water vapor or ice. Spacecraft have photographed numerous large and fine channels across the surface of Mars, with shapes and structures that indicate, almost beyond a doubt, that they were carved by running water. Where has the water gone? Only a tiny fraction is known to exist in the northern polar cap and in the atmosphere.

Some of it may have escaped into space, but scientists believe that most of it should have remained on Mars. They want to know if water could be hidden in permafrost — thick layers of ice-rock — beneath the surface, just as it is trapped in the polar regions on Earth. The origin and evolution of Mars are still a mystery. Thought to have formed 4.6 billion years ago, in much the same way as the other rocky planets of the inner solar system, Mars has two distinct hemispheres, roughly divided by the equator. The southern hemisphere is badly battered, perhaps the result of an intense bombardment by debris as the planet was forming. This part of Mars may be closest in history and age to the heavily cratered faces of the Moon and Mercury. Other regions of Mars may be widespread plains of volcanic lava, which erupted from within the planet over a long period of time. Similar eruptions spread across Earth's Moon to form the dark areas known as lunar maria, or "seas."

During the last 2 billion or 3 billion years, Mars also developed features that resemble those of Earth rather than the Moon. Geologic activity in the younger, northern hemisphere created huge, isolated volcanoes — most notably Olympus Mons and the other volcanoes along the Tharsis uplift — as the interior of Mars melted and lava rose to the surface. A huge canyon just below the Martian equator, called Vallis Marineris, would dwarf Earth's Grand Canyon, stretching 3,100 miles (5,000 kilometers) across the planet's surface. Many sinuous channels, apparently cut by running water that may have flooded regions of Mars hundreds of millions of years ago, also appear in the northern hemisphere.

Science Experiments

Mars Global Surveyor carries a complement of six scientific instruments which have been furnished by NASA centers as well as universities and industry. They are:

❑ **Thermal Emission Spectrometer.** This instrument will analyze infrared radiation from the surface. From these measurements, scientists can determine several important properties of the rocks and soils that make up the Martian surface: how hot and cold they get during the cycles of night and day; how well they transmit heat; the distribution of rock and grain sizes; and the amount of the surface covered by large rocks and boulders. Scientists will also be able to identify minerals in solid rocks and sand dunes, which will be key to understanding how Martian bedrock has weathered over millions of years and how it might be weathering today. The instrument can also provide information about the Martian atmosphere, especially the locations and nature of short-lived clouds and dust. Principal investigator is Dr. Philip Christensen, Arizona State University.

❑ **Mars Orbiter Laser Altimeter**. This experiment will measure the height of Martian surface features. A laser will fire pulses of infrared light 10 times each second, striking a 525-foot (160-meter) area on the surface. By measuring the length of time it takes for the light to return to the spacecraft, scientists can determine the distance to the planet's surface. Data from this instrument will give scientists elevation maps precise to within about 100 feet (30 meters) from which they will be able to construct a detailed topographic map of the Martian landscape. Principal investigator is Dr. David Smith, NASA Goddard Space Flight Center.

❑ **Magnetometer/Electron Reflectometer**. The magnetometer/electron reflectometer will search for evidence of a planetary magnetic field and measure its strength, if it exists. These measurements will provide critical tests for current speculations about the early history and evolution of the planet. The instrument will also scan the surface to detect remnants of an ancient magnetic field, providing clues to the Martian past when the magnetic field may have been stronger due to the planet's higher internal temperature. Principal investigator is Dr. Mario Acuna, NASA Goddard Space Flight Center.

❑ **Radio Science**. The radio science investigation will use data provided by the spacecraft's telecommunications system, high-gain antenna and an onboard ultra-stable oscillator, which is like an ultra precise clock, to map variations in the gravity field by noting where the spacecraft speeds up and slows down in its passage around Mars. From these observations, a precise map of the gravity field can be constructed and related to the structure of the planet. In addition, scientists will study how radio waves are distorted as they pass through Mars' atmosphere in order to measure the atmosphere's temperature and pressure. Dr. G. Leonard Tyler, of Stanford University, is the radio science team leader.

❑ **Mars Orbiter Camera.** Unlike cameras on spacecraft such as Galileo or Voyager, which take conventional, snapshot-type exposures, the Mars orbiter camera uses a "push-broom" technique that builds up a long, ribbon-like image as the spacecraft passes over the planet. The camera will provide low-resolution global coverage of the planet every day, collecting images through red and blue filters. It will also obtain medium- and high-resolution images of selected areas. The wide-angle lens is ideal for accumulating a weather map of Mars each day, showing surface features and clouds at a resolution of about 4.6 miles (7.5 kilometers). These global views will be similar to the types of views obtained by weather satellites orbiting the Earth. The narrow-angle lens will image small areas of the surface at a resolution of 6.5 to 9.5 feet (2 to 3 meters). These pictures will be sharp enough to show small geologic features such as boulders and sand dunes — perhaps even the Mars Pathfinder lander and the now-silent Viking landers — and may also be used to select landing sites for future missions. Principal investigator is Dr. Michael Malin, Malin Space Science Systems Inc., San Diego, CA.

❑ **Mars Relay System.** Mars Global Surveyor carries a radio receiver/transmitter supplied by the French space agency, Centre National d'Etudes Spatiales, which was originally designed to support the Russian Mars '96 mission, lost during launch. Now it will be used to relay data from the microprobes carried on the 1998 Mars Global Surveyor Lander mission, as well as to serve as a backup to relay data from the lander itself. Data relayed from the surface to Mars Global Surveyor will be stored in the large solid-state memory of the orbiter's camera, where it will be processed for return to Earth. This collaborative effort will maximize data collection. Following support of the Mars '98 mission, the Mars relay system is expected to provide multiple years of in-orbit communications relay capability for future international Mars missions.

Program/Project Management

Mars Global Surveyor is the first mission in a sustained program of Mars exploration — called the Mars Surveyor program — which will send low-cost pairs of orbiters and landers to Mars every 25 months well into the next century.

The Mars Global Surveyor mission is managed by the Jet Propulsion Laboratory for NASA's Office of Space Science, Washington, DC. At NASA Headquarters, Dr. Wesley T. Huntress is associate administrator for space science. Kenneth Ledbetter is director for mission and payload development. Dr. William Piotrowski is Mars Global Surveyor program executive. Dr. Patricia Rogers is Mars Global Surveyor program scientist.

At the Jet Propulsion Laboratory, Norman Haynes is director of the Mars Exploration Directorate. Donna Shirley is manager of the Mars Exploration Program. Glenn E. Cunningham is Mars Global Surveyor project manager. Dr. Arden Albee of the California Institute of Technology, Pasadena, CA, is Mars Global Surveyor project scientist.

JPL's industrial partner is Lockheed Martin Astronautics, Denver, CO, which developed and operates the spacecraft. Navigation and ground data support are provided by JPL. Science operations will be carried out by NASA's Goddard Space Flight Center, Greenbelt, MD; Arizona State University, Tempe, AZ; Malin Space Science Systems, San Diego, CA; Stanford University, Palo Alto, CA; and NASA's Jet Propulsion Laboratory, Pasadena, CA.

J97-27

National Aeronautics and Space Administration

SPACE SHUTTLE
MISSION
STS-86

PRESS KIT
SEPTEMBER 1997

SHUTTLE MIR MISSION-07 (S/MM-07)

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ASTRONAUT WOLF CONTINUING AMERICAN PRESENCE ON MIR, JOINT U.S.-RUSSIAN SPACEWALK HIGHLIGHT STS-86 MISSION

The continuing cooperative effort in space exploration between the United States and Russia and a joint spacewalk will be the focus of NASA's seventh Shuttle mission of 1997 with the launch of Space Shuttle Atlantis on Mission STS-86.

This is the seventh of nine planned missions to Mir and the fourth one involving an exchange of U.S. astronauts. Astronaut Mike Foale, who has been on Mir since mid-May, will be replaced by astronaut David Wolf. Wolf will spend more than four months on the orbiting Russian facility. He will return to Earth on Space Shuttle Mission STS-89, scheduled for launch in January 1998.

The STS-86 crew will be commanded by Jim Wetherbee who will be making his fourth Shuttle flight. The pilot, Mike Bloomfield, will be making his first flight. There are five mission specialists assigned to this flight. Vladimir Titov, a Russian cosmonaut, serving as Mission Specialist-1, is making his fourth space flight and second flight on the Space Shuttle. Mission Specialist-2 Scott Parazynski is making his second flight. Jean-Loup Chretien of the French Space Agency (CNES) is Mission Specialist-3 and is making his third flight and first on the Shuttle. Mission Specialist-4 Wendy Lawrence and Mission Specialist-5 David Wolf are making their second space flight. Shortly after docking, Wolf and Foale will conduct their handover with Wolf becoming a member of the Mir 24 crew and Foale becoming a STS-86 Mission Specialist through the end of the flight.

Atlantis is targeted for a late evening launch on September 25, 1997 from NASA's Kennedy Space Center Launch Complex 39-A. The current launch time of 10:34 p.m. EDT may vary slightly based on calculations of Mir's precise location in space at the time of liftoff due to Shuttle rendezvous phasing requirements. The STS-86 mission is scheduled to last 9 days, 20 hours, 24 minutes. An on-time launch on Sept. 25 and nominal mission duration would have Atlantis landing back at Kennedy Space Center on October 5 just before sunset at 6:58 p.m. EDT.

Atlantis' rendezvous and docking with the Mir actually begin with the precisely timed launch setting the orbiter on a course for rendezvous with the orbiting Russian facility. Over the next two to three days, periodic firings of Atlantis' small thruster engines will gradually bring the Shuttle within close proximity to Mir.

The STS-86 mission is part of the NASA/Mir program which consists of nine Shuttle-Mir dockings and seven long duration flights of U.S. astronauts aboard the Russian space station. The U.S. astronauts will launch and land on a Shuttle and serve as Mir crew members while the Mir cosmonauts use their traditional Soyuz vehicle for launch and landing. This series of missions will expand U.S. research on Mir by providing resupply materials for experiments to be performed aboard the station as well as returning experiment samples and data to Earth.

Atlantis will again be carrying the SPACEHAB module in the payload bay of the orbiter. The double module configuration will house experiments to be performed by Atlantis' crew along with logistics equipment to be transferred to Mir.

Parazynski and Titov will conduct a five-hour spacewalk, or extravehicular activity (EVA), on the fourth day Atlantis is docked with the Mir. It will be the first U.S. spacewalk to include participation by a foreign astronaut.

Parazynski and Titov will leave Atlantis' airlock to retrieve four suitcase-sized experiments called the Mir Environmental Effects Payload (MEEP) from the exterior of Mir's Docking Module. The experiments, which were attached to the Docking Module by astronauts during Shuttle mission STS-76 in March 1996, are studying the effects of exposure to the space environment on a variety of materials.

In addition to transferring the MEEP back to Atlantis, Parazynski and Titov will leave an item on the exterior of Mir. A solar array cap to be placed on the damaged Spektr module on a later Russian space walk will be brought out of the shuttle airlock and tethered to the exterior of the Docking Module. The solar array cap is too large to be transferred through Mir, and the cap is needed to seal off the base of the damaged array on Spektr if and when the array is jettisoned by cosmonauts.

Parazynski and Titov also will continue an evaluation of the Simplified Aid For EVA Rescue (SAFER), a small jet-backpack designed for use as a type of life jacket during station assembly. Parazynski and Titov also will evaluate equipment designed to be compatible for use by spacewalkers on the U.S. and Russian segments of the International Space Station.

The current Mir 24 mission began when cosmonauts Commander Anatoly Solovyev and Flight Engineer Pavel Vinogradov were launched on August 5, in a Soyuz vehicle and docked with the Mir two days later. Mike Foale began his stay on the orbiting Russian facility with the Mir 23 crew in mid-May with the docking of STS-84. He became a member of the Mir 24 crew and continued his science investigations when the Mir 23 crew returned to Earth on August 13. Wolf is scheduled to be replaced by another NASA Astronaut when Endeavour docks with Mir in January 1998.

The STS-86 mission and the work performed by Wolf during his time on the Mir station will include investigations in the fields of advanced technology, Earth sciences, fundamental biology, human life sciences, International Space Station risk mitigation, microgravity sciences and space sciences. Because of his previous Space Shuttle extravehicular activity (EVA) spacewalk training along with Mir EVA training done at the Gagarin Cosmonaut Training Center in Star City, Russia, Wolf also may perform spacewalk activities during his tour of duty on the orbiting Russian facility.

When Atlantis undocks from Mir, the separation manevers performed will have two objectives. First, just after undocking, the Shuttle will continue to back away through a corridor similar to that used during approach with periodic stops to "stationkeep" in order to collect data for the European laser docking sensor. Atlantis will continue away from Mir until it reaches a distance of 600 feet below the Mir.

Following evaluations of the European sensor, Atlantis will then begin a re-approach to a distance of 240 feet while Mir maneuvers to an orientation that provides adequate viewing of the damaged areas of its Spektr module. After reaching the 240 foot range, Atlantis will begin a flyaround to photograph the damage from the Progress collision. Once the flyaround/photo survey activities are complete, Atlantis will perform a separation burn to move to an orbit below and ahead of Mir. Because of propellant constraints, this undocking profile may be modified during the mission.

STS-86 will be the 20th flight of Atlantis and the 87th mission flown since the start of the Space Shuttle program in April 1981.

MEDIA SERVICES INFORMATION

NASA Television Transmission

NASA Television is available through the GE2 satellite system which is located on Transponder 9C, at 85 degrees west longitude, frequency 3880.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, FL; Marshall Space Flight Center, Huntsville, AL; Dryden Flight Research Center, Edwards, CA; Johnson Space Center, Houston, TX; and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued before launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once each day. The updated NASA television schedule will indicate when mission briefings are planned.

Internet Information

Information on STS-86 is available through several sources on the Internet. The primary source for mission information is the NASA Shuttle Web, part of the World Wide Web. This site contains information on the crew and its mission and will be regularly updated with status reports, photos and video clips throughout the flight. The NASA Shuttle Web's address is:

http://shuttle.nasa.gov

If that address is busy or unavailable, Shuttle information is available through the Office of Space Flight Home Page:

http://www.osf.hq.nasa.gov/

General information on NASA and its programs is available through the NASA Home Page and the NASA Public Affairs Home Page:

http://www.nasa.gov

or http://www.gsfc.nasa.gov/hqpao/hqpao_home.html

Information on other current NASA activities is available through the Today@NASA page:

http://www.hq.nasa.gov/office/pao/NewsRoom/today.html

The NASA TV schedule is available from the NTV Home Page:

http://www.hq.nasa.gov/office/pao/ntv.html

Status reports, TV schedules and other information also are available from the NASA Headquarters FTP (File Transfer Protocol) server, ftp.hq.nasa.gov. Log in as anonymous and go to the directory /pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their E-mail address as the password. Within the /pub/pao directory there will be a "readme.txt" file explaining the directory structure:

* Pre-launch status reports (KSC): **ftp.hq.nasa.gov/pub/pao/statrpt/ksc**
* Mission status reports(JSC): **ftp.hq.nasa.gov/pub/pao/statrpt/jsc**
* Daily TV schedules: **ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked.**

NASA Spacelink, a resource for educators, also provides mission information via the Internet. Spacelink may be accessed at the following address:

http://spacelink.msfc.nasa.gov

Access by CompuServe

Users with CompuServe accounts can access NASA press releases by typing "GO NASA" (no quotes) and making a selection from the categories offered.

STS-86 QUICK LOOK

Launch Date/Site:	September 25, 1997/KSC Launch Pad 39-A
Launch Time:	10:34 PM EDT
Launch Window:	Approximately 7 minutes
Orbiter:	Atlantis (OV-104), 20th flight
Orbit Altitude/Inclination:	160 nautical miles, 51.6 degrees (213 nm for docking)
Mission Duration:	9 days, 20 hours, 24 minutes
Landing Date:	October 5, 1997
Landing Time:	6:58 PM EDT
Primary Landing Site:	Kennedy Space Center, Florida
Abort Landing Sites:	Return to Launch Site - KSC Transoceanic Abort Sites - Zaragoza, Spain; Ben Guerir, Morocco; Moron, Spain Abort-Once Around - KSC

Crew:
Jim Wetherbee, Commander (CDR), 4th flight
Mike Bloomfield, Pilot (PLT), 1st flight
Vladimir Titov, Mission Specialist 1 (MS 1), 4th flight
Scott Parazynski, Mission Specialist 2 (MS 2), 2nd flight
Jean-Loup Chretien, Mission Specialist 3 (MS 3), 3rd flight
Wendy Lawrence, Mission Specialist 4 (MS 4), 2nd flight
David Wolf, Mission Specialist 5 up, (MS 5), 2nd flight
Mike Foale, Mission Specialist 5 down, (MS 5), 4th flight

EVA Crew: Scott Parazynski (EV 1), Vladimir Titov (EV 2)

Cargo Bay Payloads:
Spacehab Double Module
Orbiter Docking System
European Proximity Sensor
MEEP Carriers
SEEDS-II

In-Cabin Payloads:
RME's
KidSat
CPCG
CREAM
CCM-A
MSX
SIMPLEX

CREW RESPONSIBILITIES

Payloads	Prime	Backup
Rendezvous and Docking	Wetherbee	Bloomfield
Undocking and Flyaround	Bloomfield	Wetherbee
Rendezvous Tools	Parazynski	Titov
Orbiter Docking System	Parazynski	Chretien
Russian Language	Chretien	Titov
Spacehab	Chretien	Titov
Logistics Transfers	Titov	Chretien
Water Bag Fills	Titov	Others
EVA	Parazynski	Titov
Intravehicular Crewmember	Bloomfield	------
CPCG	Bloomfield	------
CCM-A	Wetherbee	------
SIMPLEX	Bloomfield	Wetherbee
MSX	Bloomfield	Wetherbee
KidSat	Bloomfield	------
SEEDS-II	Chretien	------
Earth Observations	Parazynski	Others
Ascent Seat on Flight Deck	Titov	------
Entry Seat on Flight Deck	Chretien	------
Recumbent Seat Setup	Titov	Foale

STS-86 ORBITAL EVENTS SUMMARY

(based on a September 25, 1997 Launch)

EVENT	MET	TIME OF DAY (EDT)
Launch	0/00:00	10:34 PM, September 25
Mir Docking	1/18:56	5:30 PM, September 27
Mir Undocking	7/13:12	11:46 AM, October 3
KSC Landing	9/20:24	6:58 PM, October 5

Developmental Test Objectives / Detailed Supplementary Objectives/ Risk Mitigation Experiments

DTO 259:	Tuned Notch Filter Test
DTO 312:	External Tank TPS Performance
DTO 671:	EVA Hardware for Future Scheduled EVA Missions
DTO 700-9A:	Orbiter Evaluation of TDRS Acquisition in Despreader Bypass Mode
DTO 700-10:	Orbiter Space Vision System Videotaping
DTO 700-12:	Global Positioning System/Inertial Navigation System
DTO 700-13A:	Signal Attenuation Effects of ET During Ascent
DTO 700-15:	Space Integrated GPS/Inertial Navigation System
DTO 700-16:	S-Band Sequential Still Video Demonstration
DTO 805:	Crosswind Landing Performance
DTO 1118:	Photographic and Video Survey of Mir Space Station
DTO 1125:	Measurements of Dose as a Function of Shielding Thickness
DTO 1213:	Station Docking Target Evaluation
RME 1303-1:	Shuttle/Mir Experiment Kit Transport, Enhanced Dynamic Loads
RME 1303-2:	Shuttle /Mir Experiment Kit Transport, Mir Auxiliary Sensor Unit
RME 1303-3:	Shuttle/Mir Experiment Kit Transport, Water Experiment Kit
RME 1303-5:	Space Portable SpectroReflectometer
RME 1304:	Mir Environmental Effects Payload
RME 1314:	ESA Proximity Operations Sensor
RME 1317:	Mir Structural Dynamics Experiment
RME 1320:	Radiation Monitoring Equipment-III
RME 1324:	Volatile Organics Analyzer
RME 1332:	Space Station - Test of PCS Hardware
DSO 207:	Adaptation to Linear Acceleration after Space Flight

PAYLOAD AND VEHICLE WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Atlantis) empty and 3 SSME's	152,174
Shuttle System at SRB Ignition	4,514,873
Orbiter Weight at Landing with Cargo	251,730
Spacehab	14,447
Orbiter Docking System	4,016

MISSION SUMMARY TIMELINE

Flight Day 1:
Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
Spacehab Activation

Flight Day 2:
EMU Checkout
SAFER Checkout
Rendezvous Tool Checkout
Centerline Camera Installation
Orbiter Docking System Ring Extension

Flight Day 3:
Rendezvous and Docking
Hatch Opening and Welcoming Ceremony

Flight Day 4:
Soyuz Seat Transfer and Installation (formal transfer of Wolf for Foale)
Logistics Transfer Operations

Flight Day 5:
Greenhouse Operations
Logistics Transfer Operations

Flight Day 6:
Logistics Transfer Operations
Hatch Closure for EVA
EVA Tool Preparation

Flight Day 7:
EVA (5 hours, Parazynski and Titov)
Hatch Opening

Flight Day 8:
Final Logistics Transfer Operations and Inventory
Joint Crew News Conference
Farewell Ceremony
Final Hatch Closure

Flight Day 9:

Undocking and Flyaround Inspection of Spektr Module
Seperation Maneuver
Off Duty Time

Flight Day 10:
Flight Control System Checkout
Reaction Control System Hot-Fire
Cabin Stowage
Recumbent Seat Setup

Flight Day 11:
Payload Bay Door Closing
Deorbit Burn
KSC Landing

SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes for STS-86 include:

* Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with the orbital maneuvering system engines.

* Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit of the Earth before landing at Kennedy Space Center, Fla.

* Transoceanic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza or Moron in Spain or Ben Guerir in Morocco.

* Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, and without enough energy to reach a TAL site, would result in a pitch around and thrust back toward Kennedy until within gliding distance.

STS-86 MIR RENDEZVOUS, DOCKING & UNDOCKING

Atlantis' rendezvous and docking with the Russian Space Station Mir actually begins with the precisely timed launch of the shuttle on a course for the Mir, and, over the next two days, periodic small engine firings that will gradually bring Atlantis to a point eight nautical miles behind Mir on docking day, the starting point for a final approach to the station.

Mir Rendezvous & Docking– Flight Day 3

About two hours before the scheduled docking time on Flight Day Three of the mission, Atlantis will reach a point about eight nautical miles behind the Mir Space Station and conduct a Terminal Phase Initiation (TI) burn, beginning the final phase of the rendezvous. Atlantis will close the final eight nautical miles to Mir during the next orbit. As Atlantis approaches, the shuttle's rendezvous radar system will begin tracking Mir and providing range and closing rate information to Atlantis. Atlantis' crew also will begin air-to-air communications with the Mir crew using a VHF radio.

As Atlantis reaches close proximity to Mir, the Trajectory Control Sensor, a laser ranging device mounted in the payload bay, will supplement the shuttle's onboard navigation information by supplying additional data on the range and closing rate. As Atlantis closes in on the Mir, the shuttle will have the opportunity for four small successive engine firings to fine-tune its approach using its onboard navigation information. Flying a slightly modified rendezvous profile for improved efficiency, Atlantis will aim for a point directly below Mir, along the Earth radius vector (R-Bar), an imaginary line drawn between the Mir center of gravity and the center of Earth. Approaching along the R-Bar, from directly underneath the Mir, allows natural forces to assist in braking Atlantis' approach. During this approach, the crew will begin using a hand-held laser ranging device to supplement distance and closing rate measurements made by other shuttle navigational equipment.

Atlantis will intercept the R-Bar at a point 600 ft below Mir. Commander Jim Wetherbee will fly the shuttle using the aft flight deck controls as Atlantis begins moving up toward Mir. Because of the approach from underneath Mir, Wetherbee will have to perform very few braking firings. However, if such firings are required, the shuttle's jets will be used in a mode called "Low-Z," a technique that uses slightly offset jets on Atlantis' nose and tail to slow the spacecraft rather than firing jets pointed directly at Mir. This technique avoids contamination of the space station and its solar arrays by exhaust from the shuttle steering jets.

Using the centerline camera fixed in the center of Atlantis' docking mechanism, Wetherbee will center Atlantis' docking mechanism with the Docking Module mechanism on Mir, continually refining this alignment as he approaches within 300 feet of the station.

At a distance of about 30 feet from docking, Wetherbee will stop Atlantis and stationkeep momentarily to adjust the docking mechanism alignment, if necessary. At that time, a final go or no- go decision to proceed with the docking will be made by flight control teams in both Houston and Moscow.

When Atlantis proceeds with docking, the shuttle crew will use ship-to-ship communications with Mir to inform the Mir crew of the shuttle's status and to keep them informed of major events, including confirmation of contact, capture and the conclusion of damping. Damping, the halt of any relative motion between the two spacecraft after docking, is performed by shock absorber-type springs within the docking device. Mission Specialist Scott Parazynski will oversee the operation of the Orbiter Docking System from onboard Atlantis.

Undocking and Separation

Once Atlantis is ready to undock from Mir, the initial separation will be performed by springs that will gently push the shuttle away from the docking module. Both the Mir and Atlantis will be in a mode called "free drift" during the undocking, a mode that has the steering jets of each spacecraft shut off to avoid any inadvertent firings.

Once the docking mechanism's springs have pushed Atlantis away to a distance of about two feet from Mir, where the docking devices will be clear of one another, Atlantis' steering jets will be turned back on and fired in the Low-Z mode to begin slowly moving away from Mir.

The shuttle will continue to back away through a corridor similar to that used during approach with periodic stops to “stationkeep” in order to collect data for the European laser docking sensor. Atlantis will continue away from Mir until it reaches a distance of 600 feet below the Mir. At this point, Atlantis will begin a re-approach to a distance of 240 feet while Mir maneuvers to an orientation that provides adequate viewing of the damaged areas of its Spektr module. After reaching the 240 foot range, Atlantis will begin a flyaround to photograph the damage from the Progress collision. Once the flyaround/photo survey activities are complete, Atlantis will perform a separation burn to move to an orbit below and ahead of Mir. Because of propellant constraints, this undocking profile may be modified during the mission.

SHUTTLE-MIR ACTIVITIES & SCIENCE

EVA Development Flight Test (EDFT)

Mission Specialists Scott Parazynski and Vladimir Titov will conduct a five-hour spacewalk, or extravehicular activity (EVA), on the fourth day Atlantis is docked with the Mir. It will be the first U.S. spacewalk to include the participation of a foreign astronaut.

Parazynski is designated Extravehicular crewmember-1 (EV-1) and will be identified by red bands around each leg of his spacesuit. Titov is designated EV-2. Parazynski and Titov will leave Atlantis' airlock to retrieve four suitcase-sized experiments called the Mir Environmental Effects Payload (MEEP) from the exterior of Mir's Docking Module. The experiments were attached to the Docking Module by astronauts Linda Godwin and Rich Clifford during Shuttle mission STS-76 in March 1996.

Parazynski and Titov will exit the upward-facing hatch in the tunnel between Atlantis' crew cabin and the Spacehab module and move up the Docking Module to release the MEEP packages. The retrieved packages will be folded and stowed in sidewall carriers in Atlantis' cargo bay, two carriers located in front of the Orbiter Docking System (ODS) and two located aft of the ODS. Within the MEEP packages, investigators are studying the effects of exposure to the space environment on a variety of materials.

In addition to transferring the MEEP back to Atlantis, Parazynski and Titov will leave an item on the exterior of Mir. A solar array cap to be placed on the damaged Spektr module on a later Russian space walk will be brought out of the shuttle airlock and tethered to the exteritor of the Docking Module. The solar array cap is too large to be transferred through Mir, and is needed to seal off the base of the damaged array on Spektr if and when the array is jettisoned by cosmonauts.

The spacewalk will continue a series of EVA Development Flight Test (EDFT) spacewalks that have been conducted on six past Space Shuttle missions. The tests are designed to evaluate equipment and techniques and build experience among astronauts and ground controllers in preparation for assembly of the International Space Station. Past EDFT spacewalks have evaluated equipment ranging from the labeling to be used on the exterior of the station to the nuts and bolts to be used as connectors.

In addition to retrieving the MEEP, Parazynski and Titov will continue an evaluation of the Simplified Aid For EVA Rescue (SAFER), a small jet-backpack designed for use as a type of life jacket during station assembly. Originally evaluated on Shuttle mission STS-64, the SAFER is designed to be worn by astronauts during station spacewalks to allow them to fly back to the station under their own power in the event they become untethered. The SAFER unit to be tested on STS-86 is the first flight production model. Parazynski and Titov will be wearing the devices, and, while remaining tethered and in a foot restraint, they will evaluate the deployment of the hand controller and the firing of the automatic attitude hold feature. Firing the automatic attitude hold feature while the astronauts are in a foot restraint will test the firing mechanisms in the device, such as the valves and gas thrusters. The astronauts will not perform any free-flight testing of the SAFER as was performed on STS-64.

Parazynski and Titov also will evaluate equipment designed to be compatible for use by spacewalkers on the U.S. and Russian segments of the International Space Station. The evaluations will include a Universal Foot Restraint designed to hold the boots of both U.S. and Russian spacesuits; common safety, equipment and body restraint tethers; and a common tool carrier.

MIR Environmental Effects Payload (MEEP)

The Mir Environmental Effects Payload (MEEP) is managed by NASA's Langley Research Center, Hampton, VA, and has been studying the frequency and effects of space debris striking the Mir space station. MEEP has been gathering data on human-made and natural space debris, capturing some debris for later study. It was attached to Mir's Docking Module during a spacewalk by two Shuttle astronauts during the STS-76 mission in March 1996.

The MEEP payload has also exposed selected and proposed International Space Station materials to the effects of space and orbital debris to determine the reactions of the materials to the space environment. Because the International Space Station will be placed in approximately the same Earth orbit as Mir, flying MEEP aboard Mir is giving researchers an opportunity to test materials for the International Space Station in a comparable orbital position.

MEEP consists of four separate experiments. The Polished Plate Micrometeoroid and Debris experiment is designed to study how often space debris hit the station, the sizes of these debris, the source of the debris, and the damage the debris would do if it hit the station. The Orbital Debris Collector experiment is designed to capture orbital debris and return them to Earth to determine what the debris are made of and their possible origins.

The Passive Optical Sample Assembly I and II experiments consist of various materials that are intended for use on the International Space Station. These materials include paint samples, glass coatings, multi-layer insulation and a variety of metallic samples.

The four MEEP experiments have been attached to Mir for more than a year. The data will be studied to determine what kind of debris hit the space station and how those contaminants can actually collect on some of the different surfaces of a space station, affecting its surfaces and long-term performance.

The four MEEP experiments will be carried back in Atlantis' cargo bay. They will be contained in four Passive Experiment Carriers (PEC) – two in front of, and two behind the Orbiter Docking System.

Phase 1 Research Program

The Phase 1 Program consists of nine Shuttle-Mir dockings and seven long-duration flights of U.S. astronauts aboard the Russian space station between early 1995 and mid 1998. The U.S. astronauts will launch and land on a Shuttle and serve as Mir crewmembers for flight durations ranging from 127 to 187 days, while the Mir cosmonauts stay approximately 180 days and use their traditional Soyuz vehicle for launch and landing. This series of missions will expand U.S. research on Mir by providing resupply materials for experiments to be performed aboard Mir, as well as returning experimental samples and data to Earth.

The Mir 24 mission began when the cosmonaut crew launched on August 5, 1997, in a Soyuz vehicle and docked with the Mir two days later. Michael Foale joined the Mir 23 crew with the May 17, 1997, docking of Atlantis during Mission STS-84. The return of Atlantis on STS-86 will conclude some experiments, continue others and commence still others. Data gained from the mission will supply insight for the planning and development of the.International Space Station, Earth-based sciences of human and biological processes and the advancement of commercial technology.

Science Overview

As scientists learn more about the effects of the space environment, they continue to develop questions from the fields of human life sciences, fundamental biology, biotechnology, material sciences, and spacecraft structural and environmental dynamics. Valuable scientific information regarding these subjects will be returned from the NASA/Mir Program disciplines of advanced technology, Earth sciences, fundamental biology, human life sciences, International Space Station risk mitigation, microgravity sciences and space sciences. This knowledge will assist researchers in developing future space stations, science programs and procedures for those facilities, and advance the knowledge base of these areas to the benefit of all people on Earth.

The advanced technology discipline will evaluate new technologies and techniques using Mir as a test bed. Self-contained experiments in biotechnology, as well as pioneering work in space based metallurgy, will be conducted.

Earth sciences research in ocean biochemistry, land surface hydrology and meteorology will be performed. Observation and documentation of transient natural and human-induced changes will be accomplished with the use of hand-held photography. Residence in Earth orbit will allow for documentation of atmospheric conditions, unpredictable events, and ecological and seasonal changes over long time periods.

Fundamental biology research continues investigations to study the radiation environment of Mir, particularly in the area of charged particles.

Human life sciences research consists of investigations that focus on the crewmembers' adaptation to weightlessness in terms of skeletal muscle and bone changes, the cardiovascular system, psychological interactions and metabolism. In the Space Medicine Program, environmental factors such as water quality, air quality, surface assessment for microbes, and crew microbiology will be assessed. These ambitious investigations will continue the characterization of the integrated human responses to a prolonged presence in space.

The International Space Station risk mitigation discipline consists of several technology demonstrations associated with human factors and maintenance of crew health and safety aboard the space station. In order to improve the design and operation of the International Space Station, information is gathered to fully evaluate the Mir interior and exterior environments. This discipline includes investigations of radio interference, particle impact on the station, docked configuration stability, water microbiological monitoring and radiation monitoring.

Microgravity research will advance scientific understanding through research in biotechnology, crystal growth and materials science. The ambient acceleration and vibration environment of Mir will be characterized to support future research programs.

Most of the Mir 24/NASA research will be conducted on the Mir; however, Shuttle-based experiments will be conducted in the middeck or Spacehab modules of STS-86.

Human Life Sciences

The task of safely keeping men and women in space for long durations, whether they are doing research in Earth orbit or exploring other planets in our solar system, requires continued improvement in our understanding of the effects of spaceflight factors on the ways humans live and work. The Human Life Sciences (HLS) project has a set of investigations planned for the Mir 24/NASA 6 mission to determine how the body adapts to weightlessness and other space flight factors, including the psychological aspects of a confined environment and how they readapt to Earth's gravitational forces. The results of these investigations will guide the development of ways to minimize any negative effects so that crewmembers can remain healthy and efficient during long flights, as well as after their return to Earth.

International Space Station Risk Mitigation

The Space Portable Spetroreflectometer (SPSR) is a new tool designed to measure the effects of the space environment on spacecraft materials. This is the first hand-held, battery-powered device of its kind, allowing astronauts to measure actual spacecraft devices, rather than relying on information gathered from samples. During Extravehicular Activity (EVA) operations scheduled later this year, cosmonauts and astronauts will use this device to measure how much energy is being absorbed by the thermal control coatings, or radiator surfaces, of the Mir space station. Radiators, which are used to shed excess heat from the spacecraft, play a vital role as part of the station's cooling system.

Measurements will be used to determine the deterioration of radiator surfaces caused by the space environment. The radiator surfaces of Mir are very similar to those being manufactured for the International Space Station. Based on ground testing, researchers have constructed models of expected deterioration for the Space Station. The SPSR will provide valuable data for determining how materials degrade when exposed to the space environment.

The Space Portable Spectroreflectometer was built for the Space Environments and Effects program at NASA's Marshall Space Flight Center in Huntsville, AL by AZ Technology, In. of Huntsville.

Microgravity

The Interferometer to study Protein Crystal Growth (IPCG)– flying for the first time on STS-86 and the NASA 6 mission-- is an instrument designed to yield valuable preliminary data on how protein crystal growth differs in the microgravity environment of space. Researchers also hope to develop technologies and methods to improve the protein crystal growth process, which may help unlock future answers to the molecular structure of targeted proteins, leading to the development of new, disease-fighting drugs.

The IPCG hardware will be transported to the Mir on STS-86 and installed in the microgravity glovebox for experiment operations. Once installed, the interferometer, an instrument for measuring wavelengths of light, collects and stores optical information on a growing crystal in the facility, showing growth in form and structure, as well as in change in concentration of the protein solution surrounding the crystal. A total of three experiments will be conducted on six fluid systems. The IPCG hardware will be removed from the glovebox and returned to stowage at the completion of the experiments and returned on STS-89.
Dr. Alexander McPherson, University of California, Irvine, is the principal investigator of the IPCG experiment.

The Canadian Protein Crystallization Experiment (CAPE) is a biotechnology flight experiment developed by Canadian Space Agency scientists that could help lead to advanced treatment and possible cures for some debilitating diseases as well as bacterial and viral infections. Some of the diseases targeted include cancer, meningitis, cystic fibrosis, emphphysema, diabetes, Alzheimers, breast cancer and hypertension.

CAPE consists of wells, or small test tubes, which will be processed over a period of several months aboard the Mir. Of the 700 wells available for the project, the majority will contain samples of 32 different proteins from 15 Canadian universities and research institutions. Forty-four wells will contain student experiments.

Because protein crystals are fragile, it is difficult to grow adequately large or perfect protein crystals in Earth-based laboratories. However, the microgravity environment of space does not present gravity-induced effects such as sedimentation and convection to disrupt the growth of these fragile crystals. The chance of growing larger, more perfect crystals is greatly improved. and may significantly accelerate drug development research.

Coordination and integration of the experiment with the Shuttle/Mir Flight Program is managed by NASA's Microgravity Research Program at Marshall Space Flight Center in Huntsville, AL.

ESA ACTIVITIES ON STS-86

The European Space Agency (ESA) is again sponsoring a test of a European laser docking system that will be tested for the second time during the Shuttle's approach and departure from Mir. A GPS receiver and an optical rendezvous sensor on the Shuttle, together with equipment already installed on Mir, will be operated in an enactment of how ESA's unmanned Automated Transfer Vehicle (ATV) will approach and depart the International Space Station when it delivers supplies to it early in the next century.

During the long-range approach to Mir (starting 3 hours before docking), ESA's receivers on Atlantis and Mir will receive data from Navstar Global Positioning Satellites on the position of the other craft. The accuracy of that relative navigational data will later be compared with true data from the Shuttle's rendezvous radar.

When the Shuttle is 170 feet from Mir, the short-range experiment will begin. Navigation will be handed over to the optical rendezvous sensor. Data will later be compared with "true" figures, this time supplied by the NASA Trajectory Control System (TCS), a laser ranging device in the payload bay.

The experiments will be repeated during Atlantis' departure from Mir. As the Shuttle backs away from Mir through a corridor similar to that used during approach, periodic stops will be made to "stationkeep" in order to collect data for the European laser docking sensor. Atlantis will continue backing away from Mir until it reaches a distance of 600 feet below the Mir.

This test is last in a series of three flight demonstrations. The GPS elements of the system were tested on STS-80 in November 1996 and the first full flight test was done on the sixth Shuttle-Mir docking mission in May 1997.

STS-86 EDUCATIONAL ACTIVITIES

SEEDS-II

The Seeds in Space-II experiment will passively expose a group of tomato seeds, in hand-sewn dacron bags, to the vacuum of space. Seeds flown in the SEEDS-II payload will be compared with a control group of seeds and an experimental group of seeds located in an underwater habitat in Key Largo, Florida. Upon completion of the mission, all of the seeds will be distributed to schools for education and outreach purposes. The students will compare the experimental seeds with the control group seeds. The experiment is designed to increase student awareness of the similarities and complexities involved in the hostile ocean and space environments.

The SEEDS-II is a passive payload and does not require any power or crew interaction. The payload will be self-contained within a standard, unsealed 2.5 ft GAS canister that will be exposed to space for the duration of the mission.

KIDSAT

The STS-86 mission will support the third and final flight of KidSat, NASA's pilot education program that uses an electronic still camera aboard the Shuttle to bring the frontiers of space exploration to a growing number of U.S. middle school classrooms via the Internet.

KidSat is a NASA-sponsored research and development project that links middle school, high school and university students to Space Shuttle missions. The mission of KidSat is to understand and demonstrate how middle school students can actively make observations of the Earth by using mounted cameras onboard the

Space Shuttle to conduct scientific inquiry in support of their middle school curricula. Students engage in a process to select and analyze images of the Earth during Shuttle flights and use the tools of modern science (computers, data analysis tools and the Internet) to widely disseminate the images and results. A team environment, modeling scientific research and space operations and promoting student growth, discovery and achievement, while helping students participate in solving real-world problems, is implemented.

These students remotely operate a Kodak electronic still camera, mounted in the right overhead window on the flight-deck of the Space Shuttle, to take digital photographs of the Earth. Middle school students are responsible for planning the photo requests, which involves calculating the longitude and latitude of a region, as well as the exact time the Shuttle flies over it. High school and university students then compile the requests into a single control file that is forwarded by KidSat representatives at the Johnson Space Center (JSC) in Houston to the IBM Thinkpad connected to the camera. Using special flight software, the Thinkpad automatically commands the camera to snap the pictures requested by the middle schools. These pictures then retrace their path back down to Earth where they reach their final destination -- a computer archive. Students then can access their pictures from this archive, using the Internet.

KidSat has flown on two previous Shuttle missions: the first was in March 1996 (STS-76) and the second in January 1997 (STS-81). STS-86 marks the third and final mission of this pilot program. Three U.S. middle schools participated in the first flight. Since then, KidSat has been growing; there were 15 schools participating during the STS-81 mission, and 52 schools will participate during the STS-86 flight.

Over 300 photos were taken during STS-76, and another 500 were taken during STS-81. These can be accessed at the following URL:

http://www.jpl.nasa.gov/kidsat/

The three-year pilot program is a partnership between NASA's Jet Propulsion Laboratory (JPL), the University of California at San Diego (UCSD), and the Johns Hopkins University Institute for the Academic Advancement of Youth (JHU-IAAY).

During the Shuttle mission, the KidSat mission operations center at UCSD is staffed by undergraduate and high school students. The center is modeled after Mission Control at JSC. The students receive telemetry from the Shuttle on their computer monitors and can listen to and receive instructions from NASA's flight controllers over direct channels to JSC.

The KidSat mission operations team monitors the Shuttle's progress around the clock and continually provides up-to-date information to the middle schools, which are using the Internet to send instructions to photograph specific regions of the Earth. Since any change in the Shuttle's orbit can affect students' selections, UCSD constantly updates this information so that the middle schools may re-plan their photographic requests if necessary. This is done through a sophisticated World Wide Web site that allows students access to interactive maps of orbit ground tracks to aid in photo selection.

When the image requests have been verified by KidSat mission operations, they are compiled into a single camera control file and forwarded electronically to the KidSat representatives at JSC. They pass this file on to flight controllers who uplink it to an IBM Thinkpad connected to the KidSat camera. Software on the Thinkpad, developed by students working at JPL, uses these commands to control the camera. These same students trained the astronauts on the use of the software and the installation of the KidSat camera in the Shuttle's overhead window.

After the photographs are taken, they are sent back down to the KidSat data system at JPL, staffed by high school students during the mission and posted on the World Wide Web for the students to study and analyze. The curriculum used by the middle school students and teachers is being developed by the JHU-IAAY and UCSD.

Some of the topics the students explored during the previous KidSat missions were weather, biomes, the relationship between history and geography and the patterns of rivers on the landscape. Additional interests for these missions included searching for impact craters and studying the relationships of center pivot irrigation fields to available water supply.

The KidSat pilot program is sponsored by NASA's Office of Human Resources and Education, with support from the Offices of Space Flight, Mission to Planet Earth, and Space Science.

COMMERCIAL PROTEIN CRYSTAL GROWTH (CPCG)

The Commercial Protein Crystal Growth (CPCG) payload is comprised of a Commercial Refrigerator/Incubator Module (CRIM) designed as a generic carrier, and the Commercial Vapor Diffusion Apparatus (CVDA) experiment. The primary objective of the CVDA experiment is to produce large, high-quality crystals of selected proteins under controlled conditions in microgravity. Crystals of sufficient size and suitable quality are essential for protein crystallographic analysis of molecular structures via X-ray diffraction and computer modeling.

The vapor diffusion method of protein crystal growth is a technique by which protein crystallization is initiated through change in protein/precipitant concentrations. Water vapor is transported from a droplet protein/precipitant solution at a given pH to a reservoir containing a relatively high concentration of precipitating agent. The process is driven by drop-reservoir vapor pressure difference in a closed volume. Typical precipitating agents are ammonium sulfate, sodium chloride, polyethylene glycol, and methyl pentane diol.

The CVDA design provides a better thermal environment for samples as well as providing a larger number of experiments per CRIM, 128 as compared with 60 per old VDA configuration. Each CVDA Chamber Block consists of four experiment chambers per row. The assembly will have eight rows of experiment chambers, thus 128 per assembly.

COSMIC RADIATION EFFECTS AND ACTIVATION MONITOR (CREAM)

The Cosmic Radiation Effects and Activation Monitor will be used to collect data on cosmic ray energy loss spectra, neutron fluxes and induced radioactivity as a function of geomagnetic coordinates and detector location within the orbiter. Payload hardware consists of the active cosmic ray monitor, a passive scintillation crystal canister, two neutron spectrometers and 10 passive detector packages. The active monitor will be used to obtain real-time spectral data, while the passive monitors will obtain data integrated over the mission duration. An additional control passive detector package will be used for obtaining background data prior to launch.

The CREAM active monitor is a box containing sensors and associated electronics and solid-state memory. The active monitor will be rotated between two passive package locations throughout the mission. CREAM uses three different types of passive detectors. The first is a set of scintillation crystals packaged in an aluminum canister that will remain in a central location within Mir throughout the mission.

There are also passive detector packages, which contain nickel and gold activation foils, neutron bubble dosimeters and thermoluminescent dosimeters. Eight of these packages will be placed in four specific locations within Mir, while the remaining two will remain in the central location within Mir. The third type of passive detector is the neutron spectrometer, which consists of three identical sets of six gel-filled test tubes. The "test tubes," or neutron bubble detectors, are designed to measure specific energy thresholds of the neutron environment within Mir.

CELL CULTURE MODULE-A (CCM-A)

The Cell Culture Module-A payload was formerly known as the Space Tissue Loss / National Institutes of Health-Cells Configuration A. The payload objectives are to validate models for muscle, bone and endothelial cell biochemical and functional loss induced by microgravity stress; to evaluate cytoskeleton, metabolism, membrane integrity and protease activity in target cells; and to test tissue loss pharmaceuticals for efficacy. The experiment unit fits into a single standard middeck locker that has a modified locker door with its panels removed. The unit takes in and vents air to the cabin via the front panel. The experiment is powered and functions continuously from pre-launch through post-landing.

The analysis module includes the sealed fluid path assembly containing the cells under study, all media for sustained growth, automated drug delivery provisions for testing of candidate pharmaceuticals, inline vital activity and physical environment monitors, integral fraction collection capabilities and cell fixation facilities.

Experiment activities can be performed without any crew intervention other than initiation of the experiment at the beginning of on-orbit payload operations and termination of the experiment prior to deorbit preparation.

SHUTTLE IONOSPHERIC MODIFICATION WITH PULSED LOCAL EXHAUST (SIMPLEX)

The Shuttle Ionospheric Modification with Pulsed Local Exhaust payload of opportunity has no flight hardware; orbiter OMS thruster firings will be used to create ionospheric disturbances for observation by the SIMPLEX radars. SIMPLEX has three different radar sites used for collecting data: 1) Arecibo, 2) Kwajalein, and 3) Jicamarca. One of the radar sites (Arecibo) will also use a low-level laser to observe the effects on the ionosphere resulting from the thruster firing.

The objective of the SIMPLEX activity is to determine the source of Very High Frequency (VHF) radar echoes caused by the Orbiter and its OMS engine firings. The principal investigator (PI) will use the collected data to examine the effects of orbital kinetic energy on ionospheric irregularities and to understand the processes that take place with the venting of exhaust materials. SIMPLEX sensors may collect data during any encounter opportunity when the orbiter support activities meet the criteria defined.

STS-86 CREW BIOGRAPHIES

James D. Wetherbee (Commander, USN)
STS-86 Mission Commander

PERSONAL DATA - Born November 27, 1952, in Flushing, New York. Considers Huntington Station, New York, his hometown. Married to the former Robin DeVore Platt of Jacksonville, Florida. They have two children. He enjoys tennis, skiing, softball, running, and music. His parents, Mr. and Mrs. Dana A. Wetherbee, reside in Huntington Station, New York. Her parents, Mr. and Mrs. Harry T. Platt, Jr., reside in Jacksonville, Florida.

EDUCATION - Graduated from Holy Family Diocesan High School, South Huntington, New York, in 1970; received a bachelor of science degree in aerospace engineering from the University of Notre Dame in 1974.

ORGANIZATIONS - Member of the Society of Experimental Test Pilots.

SPECIAL HONORS - Distinguished Flying Cross; Navy Achievement Medal; two Meritorious Unit Commendations.

EXPERIENCE - Wetherbee received his commission in the United States Navy in 1975 and was designated a naval aviator in December 1976. After training in the A-7E, he was assigned to Attack Squadron 72 (VA-72) from August 1977 to November 1980 aboard the USS John F. Kennedy and logged 125 night carrier landings. After attending the U.S. Naval Test Pilot School, Patuxent River, Maryland, in 1981 he was assigned to the Systems Engineering Test Directorate. He was a project officer and test pilot for the weapons delivery system and avionics integration for the F/A-18 aircraft. Subsequently assigned to Strike Fighter Squadron 132 (VFA-132), Wetherbee flew operationally in the F/A-18 from January 1984 until his selection for the astronaut candidate program. He has logged over 4,200 hours flying time and 345 carrier landings in 20 different types of aircraft.

NASA EXPERIENCE - Selected by NASA in May 1984, Wetherbee became an astronaut in June 1985. A veteran of three space flights, Wetherbee has logged over 696 hours in space. He was the pilot on STS-32 in 1990, and was the mission commander on STS-52 in 1992 and STS-63 in 1995. From February to December 1996, Wetherbee served as Deputy Director of the Johnson Space Center. Wetherbee will command an international crew on STS-86, NASA's seventh Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for September 1997.

STS-32 Columbia (January 9-20, 1990) saw the successful deployment of the Syncom IV-F5 satellite, and retrieval of the 21,400-pound Long Duration Exposure Facility (LDEF) using the remote manipulator system (RMS). The crew also operated a variety of middeck experiments and conducted numerous medical test objectives, including in-flight aerobic exercise and muscle performance to evaluate human adaptation to extended duration missions. Mission duration was 261 hours, 01 minute, 38 seconds.

STS-52 Columbia (October 22 to November 1, 1992) successfully deployed the Laser Geodynamic Satellite (LAGEOS), a joint Italian-American project. The crew also operated the first U.S. Microgravity Payload (USMP) with French and American experiments, and successfully completed the initial flight tests of the Canadian-built Space Vision System (SVS). Mission duration was 236 hours, 56 minutes, 13 seconds.

STS-63 Discovery (February 2-11, 1995), was the first flight of the new joint Russian-American Space Program. Mission highlights included the rendezvous with the Russian Space Station, Mir, operation of Spacehab, and the deployment and retrieval of Spartan 204. The mission was accomplished in 129 orbits, travelling over 2.9 million miles in 198 hours, 29 minutes.

Michael J. Bloomfield (Major, USAF)
STS-86 Pilot

PERSONAL DATA - Born March 16, 1959, in Flint, Michigan. Considers Lake Fenton, Michigan, to be his hometown. Married to the former Lori Ann Miller. They have two children He enjoys reading, gardening, all sporting activities including running, softball, skiing, and any activity with his children His parents, Rodger and Maxine Bloomfield, reside in Linden, Michigan. Her parents, Dave and Donna Miller, reside in Albuquerque, New Mexico.

EDUCATION - Graduated from Lake Fenton High School, Fenton, Michigan, in 1977. Bachelor of science degree in engineering mechanics from the U.S. Air Force Academy, 1981. Master of science degree in engineering management from Old Dominion University, 1993.

ORGANIZATIONS - Member of the United States Air Force Academy Association of Graduates, the Air Force Association, and the Society of Experimental Test Pilots.

SPECIAL HONORS - Captain, 1980 United States Air Force Academy Falcon Football Team. Voted to the 1980 WAC All-Academic Football Team. Commanders Trophy winner as top graduate from Air Force Undergraduate Pilot Training (1983). Distinguished Graduate of USAF Test Pilot School Class 92A. Awarded the Air Force Meritorious Service Medal, the Air Force Commendation Medal, and the Air Force Aerial Achievement Medal.

EXPERIENCE - Bloomfield graduated from the USAF Academy in 1981. He completed Undergraduate Pilot Training at Vance Air Force Base (AFB), Oklahoma, in 1983, and was selected to fly the F-15. From 1983 until 1986, he served as a combat ready pilot and instructor pilot in the F-15 at Holloman AFB, New Mexico. In 1987, Bloomfield was re-assigned to Bitburg Air Base, Germany, where he served as an F-15 instructor pilot and completed the United States Fighter Weapons Instructor Course. In 1989 he was subsequently assigned to the 48th Fighter Interceptor Squadron at Langley AFB, Virginia. serving as an F-15 squadron weapons officer until 1992, when he was selected for the USAF Test Pilot School. Honored as a distinguished graduate in 1992, Bloomfield remained at Edwards AFB, California, where he conducted tests in all models of the F-16. While a member of the 416th Flight Test Squadron, Bloomfield served as squadron safety officer and as squadron flight commander. In March 1995, he was assigned to NASA as an astronaut candidate.

NASA EXPERIENCE - Selected by NASA in December 1994, Bloomfield reported to the Johnson Space Center in March 1995, has completed a year of training and evaluation, and is currently qualified for assignment as a shuttle pilot. He was initially assigned to work technical issues for the Operations Planning Branch of the Astronaut Office. He is currently assigned to serve as pilot on STS-86, NASA's seventh Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for September 1997.

Vladimir Georgievich Titov (Colonel, Russian Air Force)
Russian Cosmonaut / STS-86 Mission Specialist

PERSONAL DATA - Born January 1, 1947, in Sretensk, in the Chita Region of Russia. Married to the former Alexandra Kozlova of Ivanovo Region, Russia. They have two children. He enjoys tennis, hunting, and spending time with his family. His mother, Vera Titova, resides in Star City, Russia. His father, Georgie Titov, died in 1961. Her parents, Ruric and Alevtina Kozlov, reside in Ivanovo Region.

EDUCATION - Graduated from secondary school in 1965, from the Higher Air Force College in Chernigov in the Ukraine in 1970, and the Yuri Gagarin Air Force Academy in 1987.

SPECIAL HONORS - Awarded the title of Hero of the Soviet Union, and recipient of the Order of Lenin (1983, 1988). In 1988, the French awarded him the title of Commandeur de la Legion d'Honneur, and in 1990 he and Manarov were awarded the U.S. Harmon Prize -- the first Soviet citizens to win the award -- in recognition of their world endurance record.

EXPERIENCE - In 1966, Vladimir Titov enrolled at the Higher Air Force College in Chernigov in the Ukraine, graduating in 1970. Until 1974, he served at the College as a pilot-instructor and was responsible for the graduation of twelve student pilots. He later served as a flight commander with the air regiment where the cosmonauts carry out flying practice. He has flown 10 different types of aircraft, has logged more than 1,400 hours flying time, and holds the qualifications of Military Pilot, 1st Class, and Test Pilot, 3rd Class.

Vladimir Titov was selected to join the cosmonaut team in 1976, and in September 1981 was paired with Gennady Strekalov. The two men served as the back-up crew for Soyuz T-5 in 1982 and Soyuz T-9 in 1983. A three-flight veteran, Titov served as commander on Soyuz T-8 and Soyuz T-10 in 1983, and Soyuz TM-4 in 1987. He has logged a total of 13 hours 47 minutes of EVA, and has spent a total of 367 days, 23 hours, 2 minutes, and 18 seconds in space (including the Soyuz T-10 launch abort).

Titov made his first space flight on April 20, 1983, as commander of Soyuz T-8. He and Strekalov had been specifically trained to repair the faulty Salyut 7 solar array. He was supposed to dock with Salyut 7, but once in orbit the Soyuz rendezvous radar antenna failed to deploy properly. Several attitude control maneuvers at high rates were made but failed to swing the boom out. (The postflight inquiry later discovered that the antenna had been torn off when the Soyuz payload shroud separated.) With FCC permission, the crew attempted a rendezvous using only an optical sight and ground radar inputs for guidance. During the final approach, which was made in darkness, Titov believed that the closing speed was too great. He therefore attempted a braking maneuver, but felt that the two spacecrafts were still closing too fast. He aborted the rendezvous to avoid a crash, and no further attempts were made before the three men returned to Earth after a flight lasting just 2 days, 17 minutes, and 48 seconds.

Titov and Strekalov were then scheduled for launch on board what should have been Soyuz T-10 on September 27, 1983. However, a valve in the propellant line failed to close at T-90 seconds, causing a large fire to start at the base of the launch vehicle only one minute before launch. The fire quickly engulfed the rocket, and the automatic abort sequence failed as the wires involved burned through. Two launch controllers manually aborted the mission by sending radio commands from the launch blockhouse. This was accomplished 12 seconds after the fire began. The Soyuz descent module was pulled clear by the launch escape system, and after being subjected to 15-17 G's, the crew landed safely some 2.5 miles (4 km) from the launch vehicle, which apparently exploded seconds after the Soyuz separated. The two men were given a medical check-up, but had sustained no injuries during their brief flight which lasted 5 minutes and 30 seconds.

Titov was next assigned to command Soyuz TM-2. He and his flight engineer, Alexander Serebrov, were scheduled for a long-duration flight on board Mir 1. Six-days prior to launch, due to doubts about Serebrov's health, they were replaced by the back-up crew. Titov continued training for a long-duration mission, and in April 1987 was paired with Musa Manarov. Later that year, he graduated from the Yuri Gagarin Air Force Academy while continuing his work at the Yuri Gagarin Cosmonaut Training Center.

His next assignment came as the commander of Soyuz TM-4, which launched on December 21, 1987. Together with Musa Manarov and Anatoli Levchenko, he linked up with the orbiting Mir 1 space station and her crew. After a short period of joint work, Romanenko, Alexandrov, and Levchenko returned to Earth handing over the space station to Titov and Manarov. The two men settled down to a long program of scientific experiments and observations, and played host to the visiting Soyuz TM-5 and TM-6 missions. At the end of the Soyuz TM-6 visit, one of its crew, Dr. Valeri Polyakov, remained on board with Titov and Manarov.

On February 26, 1988, the two cosmonauts carried out an EVA lasting 4 hours and 25 minutes, during which they removed one of the sections of the solar panel and installed a new one. They also installed some new scientific experiments and removed samples of material that had been left exposed to open space, and inspected the Progress 34 spacecraft.

On June 30, 1988, they attempted a repair on the Roentgen X-ray telescope. The telescope had not been designed for repair or replacement so the EVA was a difficult one. As they sliced through the 20-layer thick thermal blanket to expose the telescope's faulty X-ray detector unit, the two men had to stop and rest several times, as they had nowhere to anchor themselves, and had to take turns holding each other steady. Their bulky gloves made removing the small bolts very difficult, and it took 90 minutes instead of the 20 allocated. When a special wrench they were using suddenly snapped, the EVA had to be aborted, and the two men returned inside the Mir, having spent 5 hours and 10 minutes in open space.

On October 20, 1988, repairs were successfully completed, and the X-ray telescope recommenced operations. The cosmonauts also installed some anchor points for the EVA scheduled for the joint Soviet-French mission, installed a new shortwave aerial, and took samples of a film which had formed over one of the portholes, before returning inside the Mir after 4 hours and 12 minutes. They then settled down to their program of experiments and observations. In November 1988, they played host to the joint Soviet-French mission. After three weeks of joint work, Titov and Manarov returned to Earth together with the French cosmonaut Jean-Loup Chretien. Titov and Manarov returned to Earth after a mission lasting 365 days, 22 hours, 39 minutes, setting a new record, and exceeding one year in space for the first time.

On October 28, 1992, NASA announced that an experienced cosmonaut would fly aboard the STS-60 Space Shuttle mission. Titov was one of two candidates named by the Russian Space Agency for mission specialist training at the Johnson Space Center. In April 1993, he was assigned as back-up mission specialist for Sergei Krikalev, who flew on STS-60 the first joint U.S./Russian Space Shuttle Mission (February 3-11, 1994). In September 1993, Titov was selected to fly on STS-63 with Krikalev training as his back-up.

From February 2-11, 1995, Titov was a mission specialist aboard the Orbiter Discovery, on STS-63, the first flight of the new joint Russian-American Space Program. Mission highlights included the rendezvous with the Russian Space Station, Mir, operation of Spacehab, and the deployment and retrieval of Spartan 204. In completing this mission, he logged an additional 198 hours and 29 minutes in space.

CURRENT EXPERIENCE - Colonel Titov will serve as a mission specialist on STS-86, NASA's seventh scheduled Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for September 1997.

Scott E. Parazynski (M.D.)
STS-86 Mission Specialist

PERSONAL DATA - Born July 28, 1961, in Little Rock, Arkansas. Considers Palo Alto, California, and Evergreen, Colorado, to be his hometowns. Married to the former Gail Marie Vozzella. They have one son. He enjoys mountaineering, rock climbing, flying, scuba diving, skiing, travel, and nature photography.

EDUCATION - Attended junior high school in Dakar, Senegal, and Beirut, Lebanon. Attended high school at the Tehran American School, Iran, and the American Community School, Athens, Greece, graduating in 1979. He received a bachelor of science degree in biology from Stanford University in 1983, continuing on to graduate with honors from Stanford Medical School in 1989. He served his medical internship at the Brigham and Women's Hospital of Harvard Medical School (1990). He then completed 22 months of a residency in emergency medicine in Denver, Colorado, when selected to the astronaut program.

ORGANIZATIONS - Member of the Aerospace Medical Association, the American Society for Gravitational and Space Biology, the Wilderness Medical Society, the American Alpine Club, and the Association of Space Explorers.

SPECIAL HONORS - National Institutes of Health Predoctoral Training Award in Cancer Biology (1983). Rhodes Scholarship finalist (1984). NASA Graduate Student Researcher's Award (1988). Stanford Medical Scholars Program (1988). Research Honors Award from Stanford Medical School (1989). NASA-Ames Certificate of Recognition (1990). Wilderness Medical Society Research Award (1991). NASA Space Flight Medal (1994).

While in medical school he competed on the United States Development Luge Team and was ranked in the top 10 in the nation during the 1988 Olympic Trials. He also served as an Olympic Team Coach for the Philippines during the 1988 Olympic Winter Games in Calgary, Canada.

EXPERIENCE - While an undergraduate at Stanford University, Dr. Parazynski studied antigenic variation in African Sleeping Sickness, using sophisticated molecular biological techniques. While in medical school, he was awarded a NASA Graduate Student Fellowship and conducted research on fluid shifts that occur during human space flight. Additionally, he has been involved in the design of several exercise devices that are being developed for long-duration space flight, and has conducted research on high-altitude acclimatization. Dr. Parazynski has numerous publications in the field of space physiology, and has a particular expertise in human adaptation to stressful environments.

NASA EXPERIENCE - Selected by NASA in March 1992, Dr. Parazynski reported to the Johnson Space Center in August 1992. He completed one year of training and evaluation, and qualified for assignment as a mission specialist on future Space Shuttle flight crews. Dr. Parazynski initially served as one of the crew representatives for extravehicular activity in the Astronaut Office Mission Development Branch. He first flew in 1994 on STS-66 and has logged over 262 hours in space. He was then assigned as a backup for the third American long-duration stay aboard Russia's Space Station Mir, and was expected to serve as a prime crew member on a subsequent mission. He spent 5 months in training at the Gargarin Cosmonaut Training Center, Star City, Russia. In October 1995, when sitting-height parameters raised concerns about his fitting safely in the Soyuz vehicle in the event of an emergency on-board the Mir station, he was deemed too tall for the mission and was withdrawn from Mir training. He presently serves as the Astronaut Office Operations Planning Branch crew representative for Space Shuttle, Space Station and Soyuz training, and is assigned to the crew of STS-86.

CURRENT ASSIGNMENT - Dr. Parazynski will serve as Mission Specialist-2 (Flight Engineer) on STS-86, NASA's seventh scheduled Shuttle mission to rendezvous and dock with the Russian Space Station Mir. While docked, he and Russian cosmonaut Vladimir Titov will perform a 5-1/2 hour EVA to retrieve experiments first deployed on Mir during the STS-76 docking mission. Launch is scheduled for September 1997.

Jean-Loup J.M. Chrétien (Brigadier-General, French Air Force)
CNES Astronaut - STS-86 Mission Specialist

PERSONAL DATA - Born August 20, 1938, in the town of La Rochelle, France. Married to Amy Kristine Jensen of New Canaan, Connecticut. Five children (one deceased). Hobbies include skiing in Winter and sailing in Summer. He also enjoys golf, wind-surfing, car-rallying and woodworking. In addition, he plays the church organ, and took an electric one with him during his first stay in Star City, Russia. His father, Jacques, was a Navy sailor, and his mother, the former Marie-Blanche Coudurier, was a housewife. Her parents, Nels and Betty Jensen, reside in Tarpon Springs, Florida.

EDUCATION - Chrétien was educated at L'Ecole communale a Ploujean, the College Saint-Charles a Saint-Brieuc, and the Lycee de Morlaix. He entered L'Ecole de l' Air (the French Air Force Academy) at Salon deProvence in 1959, and graduated in 1961, receiving a master's degree in aeronautical engineering.

ORGANIZATIONS - Member of the board of the Accademie de l' Air et de l' Espace, and the French Air and Space Museum. Counselor for Space Activities (Manned) to the President of Dassault Aviation. Counselor to the President of Air France. Member of the American Institute of Aeronautics and Astronautics, the International Academy of Astronautics, and the Association of Space Explorers.

SPECIAL HONORS - Awarded the title of Hero of the Soviet Union. Recipient of the Order of Lenin; the Order of the Red Banner of Labor; Commandeur de la Légion d'Honneur (Commander of the Order of the Legion of Honor); Chevalier de l'Ordre National du Mérite (Knight of the National Order of Merit); Titulaire de la Médaille de l'Aéronautique (Holder of the Aeronautics Medal), and honorary citizenship of Arkalyk.

EXPERIENCE - Chrétien received his fighter pilot/pilot-engineer wings in 1962, after one year of training on Mystere-4's. He was promoted to Lieutenant, and joined the 5th Fighter Squadron in Orange, in the Southeast of France, where he served for seven years as a fighter-pilot in an operational squadron flying Super-Mystere B2's and then Mirage III interceptors. In 1970, he was assigned to the French test pilots school, EPNER (Ecole du Personnel Navigant d'Essais et de Réception), then served as a test-pilot at the Istres Flight Test Center for seven years. During that time he was responsible for supervising the flight test program for the Mirage F-1 fighter. In 1977-78, he was appointed Deputy Commander of the South Air Defense Division in Aix en Provence, and he served in this position until his selection as a cosmonaut in June 1980. Chrétien remained a French Air Force officer but was placed on detachment to CNES for his space flight activities ensuring his availability for future flights with the Shuttle (NASA), Mir (Soviet Union) or Spacelab (ESA). He has accumulated over 6000 hours of flying time in various aircraft, including

Russia's Tupolev 154, MIG 25, and Sukoi 26 and 27. A veteran of two space flights, Chrétien was the 10th Intercosmos cosmonaut, and has spent a total of 32 days 15 hours 57 minutes and 52 seconds in space.

In April 1979, the Soviet Union offered France the opportunity to fly a cosmonaut on board a joint Soviet-French space flight, along the same lines as the agreement to fly non-Soviet cosmonauts from member countries of the Intercosmos program. The offer was accepted, and France began a cosmonaut selection program in September 1979. Chrétien was one of two finalists named on June 12, 1980. He started training at the Yuri Gagarin Cosmonaut Training Center in September 1980. The following year he was named as the research-cosmonaut for the prime crew of the Soyuz T-6 mission.

Soyuz T-6 was launched on June 24, 1982, and Chrétien, Dzhanibekov and Ivanchenkov linked up with Salyut 7 and joined the crew of Berezovoi and Lebedev already on board. They spent nearly seven days carrying out a program of joint Soviet-French experiments, including a series of French echography cardiovascular monitoring system experiments, before returning to Earth after a flight lasting 7 days 21 hours 50 minutes and 42 seconds.

Following the mission he was appointed Chief, CNES Astronaut Office.

Chrétien was selected as the back-up payload specialist for STS-51G. During 1984-85, he participated in mission training at the Johnson Space Center.

Chrétien made his second space flight as a research-cosmonaut on board Soyuz TM-7, which launched on November 26, 1988. Together with Volkov and Krikalev, he linked up with Mir 1 and joined the crew of Titov Manarov and Polyakov already on board. They spent 22 days carrying out a program of joint Soviet-French experiments, including a 5 hour 57 minute EVA by Volkov and Chrétien during which the two men installed the French ERA experimental deployable structure and a panel of material samples. In making the EVA, he became the first non-American and non-Soviet cosmonaut to walk in space. In addition, he was the first non-Soviet cosmonaut to make a second space flight aboard a Soviet spacecraft. The mission lasted 24 days 18 hours and 7 minutes.

During 1990-93, Chrétien participated in Buran spacecraft pilot training at the Moscow Joukovski Institute. He has also flown the Tupolev 154 and MIG 25 aircraft, flying simulators equivalent to the Shuttle Training Aircraft (STA).

Chrétien is fluent in English and Russian.

NASA EXPERIENCE - Chrétien attended ASCAN Training at the Johnson Space Center during 1995. He was initially assigned to work technical issues for the

Operations Planning Branch of the Astronaut Office. He is currently assigned as a mission specialist on STS-86, NASA's seventh Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for September 1997.

Wendy B. Lawrence (Commander, USN)
STS-86 Mission Specialist

PERSONAL DATA - Born July 2, 1959, in Jacksonville, Florida. She enjoys running, rowing, triathlons and gardening. Her father, Vice Admiral William P. Lawrence (USN, retired), resides in Crownsville, Maryland. Her mother, Anne Haynes, resides in Alvadore, Oregon.

EDUCATION - Graduated from Fort Hunt High School, Alexandria, Virginia, in 1977; received a bachelor of science degree in ocean engineering from U.S Naval Academy in 1981; a master of science degree in ocean engineering from Massachusetts Institute of Technology (MIT) and the Woods Hole Oceanographic Institution (WHOI) in 1988.

ORGANIZATIONS - Phi Kappa Phi; Association of Naval Aviation; Women Military Aviators; Naval Helicopter Association.

SPECIAL HONORS - Awarded the Defense Superior Service Medal, the NASA Space Flight Medal, the Navy Commendation Medal and the Navy Achievement Medal. Recipient of the National Navy League's Captain Winifred Collins Award for inspirational leadership (1986).

EXPERIENCE - Lawrence graduated from the United States Naval Academy in 1981. A distinguished flight school graduate, she was designated as a naval aviator in July 1982. Lawrence has more than 1,500 hours flight time in six different types of helicopters and has made more than 800 shipboard landings. While stationed at Helicopter Combat Support Squadron SIX (HC-6), she was one of the first two female helicopter pilots to make a long deployment to the Indian Ocean as part of a carrier battle group. After completion of a master's degree program at MIT and WHOI in 1988, she was assigned to Helicopter Anti-Submarine Squadron Light THIRTY (HSL-30) as officer-in-charge of Detachment ALFA. In October 1990, Lawrence reported to the U.S. Naval Academy where she served as a physics instructor and the novice women's crew coach.

NASA EXPERIENCE - Selected by NASA in March 1992, Lawrence reported to the Johnson Space Center in August 1992. She completed one year of training and is qualified for assignment as a mission specialist on future Space Shuttle missions. Her technical assignments within the Astronaut Office have included: flight software verification in the Shuttle Avionics Integration Laboratory (SAIL); Astronaut Office Assistant Training Officer. She flew on STS-67 in March 1995. She served as Director of Operations for NASA at the Gagarin Cosmonaut Training Center in Star City, Russia, with responsibility for the coordination and implementation of mission operations activities in the Moscow region for the joint U.S./Russian Shuttle/Mir program. In September 1996 she began training for a 4-month mission on the Russian Space Station Mir, but in July 1997 NASA decided to replace Lawrence with her back-up, Dr. David Wolf. This decision enables Wolf to act as a backup crew member for spacewalks planned over the next several months to repair the damaged Spektr module on the Russian outpost. Lawrence will also fly with the STS-86 crew because of her knowledge and experience with Mir systems and with crew transfer logistics for the Mir.

Lawrence flew as the ascent/entry flight engineer and blue shift orbit pilot on STS-67 in March 1995. This mission was the second flight of the ASTRO observatory, a unique complement of three telescopes. During this record-setting 16-day mission, the crew conducted observations around the clock to study the far ultraviolet spectra of faint astronomical objects and the polarization of ultraviolet light coming from hot stars and distant galaxies. Mission duration was 399 hours and 9 minutes.

David A. Wolf (M.D.)
STS-86 / Mir 24 / STS-89

PERSONAL DATA - Born August 23, 1956, in Indianapolis, Indiana. Single. He enjoys sport aerobatic flying, scuba diving, handball, running, and water skiing. His parents, Dr. and Mrs. Harry Wolf, reside in Indianapolis.

EDUCATION - Graduated from North Central High School, Indianapolis, Indiana, in 1974; received a bachelor of science degree in electrical engineering from Purdue University in 1978, and a doctorate of medicine from Indiana University in 1982. He completed his medical internship (1983) at Methodist Hospital in Indianapolis, Indiana, and USAF flight surgeon primary training at Brooks Air Force Base in San Antonio, Texas.

ORGANIZATIONS - Member of the Institute of Electrical and Electronics Engineers; the Aerospace Medical Association; the Experimental Aircraft Association; the International Aerobatic Club; and the Air National Guard.

SPECIAL HONORS - Recipient of the NASA Exceptional Engineering Achievement Medal (1990); NASA Inventor of the Year, 1992. Dr. Wolf graduated "with distinction" from the honors curriculum in electrical engineering at Purdue University and received an Academic Achievement Award upon graduation from medical school. He received the Carl R. Ruddell scholarship award for research in medical ultrasonic signal and image processing. He is a member of Eta Kappa Knu and Phi Eta Sigma honorary societies. Dr. Wolf has received 11 U.S. Patents and over 20 Space Act Awards for 3-dimensional tissue engineering technologies earning the Texas State Bar Patent of the Year in 1994. He has published over 40 technical papers.

EXPERIENCE - As a research scientist at the Indianapolis Center for Advanced Research from 1980 to 1983, he developed digital signal and image processing techniques utilizing matched filter detection of high time-bandwidth product transmissions producing "state of the art" high resolution medical ultrasonic images to the 100 micron level. He also developed new doppler demodulation techniques extending the range velocity product limitation of conventional pulsed doppler systems. He is a USAF senior flight surgeon in the Air National Guard (1982 to present) and is a member of the Board of Directors of the National Inventors Hall of Fame. He has logged over 2000 hours of flight time including air combat training as a weapons systems officer (F4 Phantom jet), T-38 Talon, and competition aerobatics (PITTS Special and Christen Eagle).

NASA EXPERIENCE - In 1983, Dr. Wolf joined the Medical Sciences Division, Johnson Space Center, Houston, Texas. He was responsible for development of the American Flight Echocardiograph for investigating cardiovascular physiology in microgravity. Upon completion he was assigned as chief engineer for design of the Space Station medical facility. In 1986 he was assigned to direct development of the Space Bioreactor and associated tissue engineering and cancer research applications utilizing controlled gravitational conditions. This resulted in the state of the art NASA rotating tissue culture systems. He has particular expertise in the design of real time computer process control systems, communications, bioprocessing, physiology, fluid dynamics, and aerospace medicine. Dr. Wolf is an active public speaker.

Selected as a NASA astronaut in January 1990, Dr. Wolf became qualified for spaceflight July 1991. His technical assignments have included Orbiter vehicle processing and test at Kennedy Space Center (1991-1992), STS-58 mission specialist (1993), and spacecraft communications (CAPCOM) (1994-1995). He is qualified for Extravehicular Activity (Spacewalk), Remote Manipulator System (Robot Arm), and Rendezvous. He was the CAPCOM for the first and third Shuttle-MIR rendezvous. He recently completed training at the Gagarin Cosmonaut Training Center in Star City, Russia in preparation for a 4-month stay on the Russian Space Station Mir in September 1997. He will launch aboard Space Shuttle Atlantis as part of the STS-86 crew.

Dr. Wolf served as a mission specialist astronaut aboard Space Shuttle Columbia (STS-58), a 14 day dedicated Spacelab life sciences research mission (10/16/93-11/1/93). During this record length shuttle mission the crew conducted neurovestibular, cardiovascular, cardiopulmonary, metabolic, and musculoskeletal research utilizing microgravity to reveal fundamental physiology normally masked by earth gravity. They accomplished 225 orbits in 336 hours, 13 minutes, 01 seconds.

C. Michael Foale (Ph.D.)
STS-84 / Mir 23 & 24 / STS-86

PERSONAL DATA - Born January 6, 1957, in Louth, England, but considers Cambridge, England, to be his hometown. Married to the former Rhonda R. Butler of Louisville, Kentucky. They have two children. He enjoys many outdoor activities, particularly wind surfing. Private flying, soaring, and project scuba diving have been his other major sporting interests. He also enjoys exploring theoretical physics and writing children's software on a personal computer. His parents, Colin and Mary Foale, reside in Cambridge, England. Her parents, Reed & Dorothy Butler, reside in Louisville, Kentucky.

EDUCATION - Graduated from Kings School, Canterbury, in 1975. He attended the University of Cambridge, Queens' College, receiving a bachelor of arts degree in Physics, National Sciences Tripos, with 1st class honors, in 1978. While at Queens' College, he completed his doctorate in Laboratory Astrophysics at Cambridge University in 1982.

ORGANIZATIONS - Member of the Cambridge Philosophical Society, England, and Aircraft Owners & Pilots Association.

EXPERIENCE - While a postgraduate at Cambridge University, Foale participated in the organization and execution of scientific scuba diving projects. With the cooperation of the Greek government, he participated as both a member of one expedition and the leader of another, surveying underwater antiquities in Greece. In the fall of 1981, he dove on the 1543 ocean galleon, "The Mary Rose," as a volunteer diver, learning excavation and survey techniques in very low visibility conditions. Pursuing a career in the U.S. Space Program, Foale moved to Houston, Texas, to work on Space Shuttle navigation problems at McDonnell Douglas Aircraft Corporation. In June 1983, Foale joined NASA Johnson Space Center in the payload operations area of the Mission Operations Directorate. In his capacity as payload officer in the Mission Control Center, he was responsible for payload operations on Space Shuttle missions STS-51G, 51-I, 61-B and 61-C.

NASA EXPERIENCE - Selected as an astronaut candidate by NASA in June 1987, Foale completed a one-year training and evaluation program in August 1988. Before his first flight he flew the Shuttle Avionics Integration Laboratory (SAIL) simulator to provide verification and testing of the Shuttle flight software, and later developed crew rescue and integrated operations for International Space Station Alpha. He has served as Deputy Chief of the Mission Development Branch in the Astronaut Office, and Head of the Astronaut Office Science Support Group. He trained at the Cosmonaut Training Center, Star City, Russia, in preparation for a long duration flight on the Russian Space Station Mir. He launched aboard Space Shuttle

Atlantis on May 15, 1997. He is scheduled to return from Mir on STS-86 in September 1997.

A veteran of three space flights, Foale has logged more than 634 hours in space. He flew as a mission specialist on STS-45 (March 24 to April 2, 1992) the first of the ATLAS series of missions to address the atmosphere and its interaction with the Sun, and again as a mission specialist on STS-56, carrying ATLAS-2, and the SPARTAN retrievable satellite which made observations of the solar corona. Most recently, he served as a mission specialist on STS-63 (February 2-11, 1995), the first rendezvous with the Russian Space Station, Mir. During the flight he made a space walk (extravehicular activity) for 4 hours, 39 minutes, evaluating the effects of extremely cold conditions on his spacesuit, as well as moving the 2800-pound Spartan satellite as part of a mass handling experiment.

Video Advisory

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For Release
September 2, 1997

VIDEO ADVISORY: V97-85

VOYAGER: TWENTY YEARS AND COUNTING...

Today's video feed features animation of the Voyager spacecraft which celebrates its 20th anniversary this week. The spacecraft was launched in the fall of 1977, to explore the outer planets and their moons. Twenty years later, the spacecraft is still returning valuable data which will help NASA scientists learn more about our universe.

ITEM 1: 20TH ANNIVERSARY OF VOYAGER
Animation of Voyager.

For more information contact Doug Isbell at (202) 358-1753.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release

Jennifer McCarter
Headquarters, Washington, DC
(Phone: 202/358-1639)

September 2, 1997

Eileen Hawley
Johnson Space Center, Houston, TX
(Phone: 281/483-5111)

RELEASE: 97-188

ASTRONAUT STORY MUSGRAVE RETIRES FROM NASA

Veteran astronaut F. Story Musgrave retired from NASA today to pursue private interests in the communications industry.

Musgrave's NASA career spanned the Apollo era to the Space Shuttle program into initial development of spacewalk strategies for the International Space Station.

"Throughout the Shuttle program, from its earliest stages to the present, Story has been instrumental in developing the techniques crew members use to perform spacewalks," said David C. Leestma, director of Flight Crew Operations. "His knowledge, expertise and friendship will be sorely missed."

Musgrave, 62, joined NASA in 1967 and is a veteran of six Space Shuttle flights, having spent more than 1,281 hours in space. He first flew on STS-6 in 1983, the maiden voyage of Challenger. During that flight Musgrave and fellow astronaut Don Peterson conducted the first spacewalk of the Shuttle era. His other Shuttle flights include STS-51F aboard Challenger in 1985, STS-33 on board Discovery in 1989, STS-44 on Atlantis in 1991, and STS-61, the first Hubble Space Telescope Servicing mission aboard Endeavour in 1991, and finally STS-80 on Columbia in 1996. With STS-80, Musgrave became the oldest person ever to fly in space.

For complete biographical information on Musgrave and other astronauts, see the NASA Internet astronaut biography home page at address: http://www.jsc.nasa.gov/Bios/.

-end-

News Release

National Aeronautics and
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Mary Hardin
Jet Propulsion Laboratory, Pasadena, CA
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For Release

September 2, 1997

RELEASE: 97-189

TWO VOYAGER SPACECRAFT STILL GOING STRONG AFTER 20 YEARS

Twenty years after their launch and long after their planetary reconnaissance flybys have been completed, both Voyager spacecraft are now gaining on another milestone -- crossing that invisible boundary that separates our solar system from interstellar space, the heliopause.

Since 1989 when Voyager 2 encountered Neptune, both spacecraft have been studying the environment of space in the outer solar system. Science instruments on both spacecraft are sensing signals that scientists believe are coming from the heliopause -- the outermost edge of the Sun's magnetic field that the spacecraft must pass through before they reach interstellar space.

"During their first two decades, the Voyager spacecraft have had an unequaled journey of discovery. Today, even though Voyager 1 is now more than twice as far from the Sun as Neptune, their journey is only half over, and more unique opportunities for discovery await the spacecraft as they head toward interstellar space," said Dr. Edward Stone, the Voyager project scientist and director of NASA's Jet Propulsion Laboratory, Pasadena, CA. "The Voyagers owe their ability to operate at such great distances from the Sun to their nuclear electric power sources which provide the electrical power they need to function."

The Sun emits a steady flow of electrically charged particles called the solar wind. As the solar wind expands supersonically into space, it creates a magnetized bubble around the Sun, called the heliosphere. Eventually, the solar wind encounters the electrically charged particles and magnetic field in the interstellar gas. The boundary created between the solar wind and interstellar gas is the heliopause. Before the spacecraft reach the heliopause, they will pass through the termination shock -- the place where the solar wind abruptly slows down from supersonic to subsonic speed.

-more-

Reaching the termination shock and heliopause will be major milestones for the spacecraft because no one has been there before and the Voyagers will gather the first direct evidence of their structure. Encountering the termination shock and heliopause has been a long sought-after goal for many space physicists, and exactly where these two boundaries are located and what they are like still remains a mystery.

"Based on current data from the Voyager cosmic ray subsystem, we are predicting the termination shock to be in the range of 62 to 90 astronomical units (AU) from the Sun. Most 'consensus' estimates are currently converging on about 85 AU. Voyager 1 is currently at about 67 AU and moving outwards at 3.5 AU per year, so I would expect crossing the termination shock sometime before the end of 2003," said Dr. Alan Cummings, a co-investigator on the cosmic ray subsystem at the California Institute of Technology.

"Based on a radio emission event detected by the Voyager 1 and 2 plasma wave instruments in 1992, we estimate that the heliopause is located from 110 to 160 AU from the Sun," said Dr. Donald A. Gurnett, principal investigator on the plasma wave subsystem at the University of Iowa. (One AU is equal to 93 million miles (150 million kilometers), or the distance from the Earth to the Sun.)

"The low-energy charged particle instruments on the two spacecraft continue to detect ions and electrons accelerated at the Sun and at huge shock waves, tens of AU in radius, that are driven outward through the solar wind. During the past five years, we have observed marked variations in this ion population, but have yet to see clear evidence of the termination shock. We should always keep in mind that our theories may be incomplete and the shock may be a lot farther out than we think," said Dr. Stamatios M. Krimigis, principal investigator for the low energy charged particle subsystem at The Johns Hopkins University Applied Physics Laboratory.

Voyager 2 was launched first on Aug. 20, 1977, and Voyager 1 was launched a few weeks later on a faster trajectory on Sept. 5. Initially, both spacecraft were only supposed to explore two planets -- Jupiter and Saturn. But the incredible success of those two first encounters and the good health of the spacecraft prompted NASA to extend Voyager 2's mission to Uranus and Neptune. As the spacecraft flew across the solar system, remote-control reprogramming has given the Voyagers greater capabilities than they possessed when they left the Earth.

There are four other science instruments that are still functioning and collecting data as part of the Voyager Interstellar Mission. The plasma subsystem measures the protons in the solar wind. "Our instrument has recently observed a slow, year-long increase in the speed of the solar wind which peaked in late 1996, and we are now observing a slow decrease in solar wind velocity," said Dr. John Richardson, of the Massachusetts Institute of Technology, principal investigator on the plasma subsystem. "We think the velocity peak coincided with the recent solar minimum. As we approach the solar maximum in

2000, the solar wind pressure should decrease, which will result in the termination shock and heliopause moving inward towards the Voyager spacecraft."

The magnetometer instrument onboard the Voyagers measures the magnetic fields that are carried out into interplanetary space by the solar wind. The Voyagers are currently measuring the weakest interplanetary magnetic fields ever detected and those magnetic fields being measured are responsive to charged particles that cannot be detected directly by any other instruments on the spacecraft, according to Dr. Norman Ness, principal investigator on the magnetometer subsystem at the Bartol Research Institute, University of Delaware.

Other science instruments still collecting data include the planetary radio astronomy subsystem and the ultraviolet spectrometer subsystem.

Voyager 1 encountered Jupiter on March 5, 1979, and Saturn on Nov. 12, 1980, and then, because its trajectory was designed to fly close to Saturn's large moon Titan, Voyager 1's path was bent northward by Saturn's gravity sending the spacecraft out of the ecliptic plane, the plane in which all the planets but Pluto orbit the Sun. Voyager 2 arrived at Jupiter on July 9, 1979, and Saturn on Aug. 25, 1981, and was then sent on to Uranus on Jan. 25, 1986, and Neptune on Aug. 25, 1989. Neptune's gravity bent Voyager 2's path southward sending it also out of the ecliptic plane and on toward interstellar space.

Both spacecraft have enough electrical power and attitude control propellant to continue operating until about 2020 when the available electrical power will no longer support science instrument operation. Spacecraft electrical power is supplied by Radioisotope Thermoelectric Generators (RTGs) that provided approximately 470 watts of power at launch. Due to the natural radioactive decay of the plutonium fuel source, the electrical energy provided by the RTGs is continually declining. At the beginning of 1997, the power generated by Voyager 1 had dropped to 334 watts and to 336 watts for Voyager 2. Both of these power levels represent better performance than had been predicted before launch.

The Voyagers are now so far from home that it takes nine hours for a radio signal traveling at the speed of light to reach the spacecraft. Science data are returned to Earth in real-time to the 34-meter Deep Space Network antennas located in California, Australia and Spain. Voyager 1 will pass the Pioneer 10 spacecraft in January 1998 to become the most distant human-made object in our solar system.

Voyager 1 is currently 6.3 billion miles (10.1 billion kilometers) from Earth, having traveled 7.4 billion miles (11.9 billion kilometers) since its launch. The Voyager 1 spacecraft is departing the solar system at a speed of 39,000 miles per hour (17.4 kilometers per second).

-more-

Voyager 2 is currently 4.9 billion miles (7.9 billion kilometers) from Earth, having traveled 6.9 billion miles (11.3 billion kilometers) since its launch. The Voyager 2 spacecraft is departing the solar system at a speed of 35,000 miles per hour (15.9 kilometers per second).

JPL, a division of the California Institute of Technology, manages the Voyager Interstellar Mission for NASA's Office of Space Science, Washington, DC.

- end -

News Release

National Aeronautics and
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Washington, DC 20546
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For Release

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Headquarters, Washington, DC
(Phone: 202/358-1547)

September 3, 1997

Franklin O'Donnell/Mary Beth Murrill
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RELEASE: 97-190

CASSINI TO SURVEY WORLDS OF SATURN AND TITAN; SENDS FIRST PROBE TO MOON OF ANOTHER PLANET

The planet Saturn, its famous icy rings, and its enigmatic moon, Titan, are the prime scientific targets of the international Cassini mission, the most ambitious and far-reaching planetary exploration ever mounted. Final preparation of Cassini is now underway for a launch from Cape Canaveral, FL, in October 1997.

The mission marks the first time a space probe has attempted to land on the moon of another planet, providing the first direct sampling of the Earth-like atmosphere of Titan and the first detailed pictures of its previously hidden surface. Titan is Saturn's largest moon, nearly the size of Mars and bigger than either Mercury or Pluto.

Cassini, in development since October 1989, is a cooperative endeavor of NASA, the European Space Agency (ESA) and the Italian Space Agency, or Agenzia Spaziale Italiana. The mission will send a sophisticated robotic spacecraft equipped with 12 scientific experiments to orbit Saturn for a four-year period and study the Saturnian system in detail. The ESA-built Huygens probe that will parachute into Titan's thick atmosphere carries another six scientific instrument packages.

"With its bright, complex rings, 18 known moons and magnetic environment, Saturn is a lot like a solar system in miniature form," said Dr. Wesley T. Huntress, NASA's associate administrator for space science. "Saturn's family of rings and moons is a one-stop treasure trove, offering countless clues to the history of planetary and solar system evolution. Cassini and the Huygens probe represent our best efforts yet in our ongoing exploration of the solar system."

-more-

The launch period for Cassini's nearly seven-year journey to Saturn opens on Oct. 6 at 5:39 a.m. EDT and closes Nov. 15, 1997. A U.S. Air Force Titan IVB/Centaur launch system, the most powerful launch vehicle in the U.S. fleet, will loft Cassini onto the interplanetary trajectory that will deliver the spacecraft to Saturn almost seven years later on July 1, 2004. Cassini's primary mission concludes in July 2008.

Saturn is the second-largest planet in the solar system and is made up mostly of hydrogen and helium. Its placid-looking, butterscotch-colored face masks a windswept atmosphere where jet streams blow at 1,100 miles per hour and swirling storms roil just beneath the cloud tops. Spacecraft passing by Saturn found a huge and complex magnetic environment, called a magnetosphere, where trapped protons and electrons interact with each other, the planet, rings, and surfaces of many of the moons.

Saturn's best known feature -- its bright rings -- consists not just of a few rings but of hundreds of rings and ringlets broad and thin, composed of ice and rock particles ranging in size from grains of sand to boxcars. "Shepherd moons" found orbiting near the edges of some of the rings gravitationally herd in ring particles that would otherwise spread out into deep space.

Although it is believed to be too cold to support life, haze-covered Titan is thought to hold clues to how the primitive Earth evolved into a life-bearing planet. It has an Earth-like, nitrogen-based atmosphere and a surface that many scientists believe probably features chilled lakes of ethane and methane. Scientists believe that Titan's surface is probably coated with the residue of a sticky brown organic rain.

On Nov. 6, 2005, Huygens will descend by parachute into Titan's sky, providing our first direct sampling of Titan's atmosphere and the first detailed photos of its hidden surface.

The Cassini spacecraft is the most complex interplanetary spacecraft ever built. Because of Cassini's challenging mission, the long distance Cassini must travel, and the value of its scientific return, each component and the system as a whole has undergone an unprecedented program of rigorous testing for quality and performance.

"Every phase of the mission has been reviewed and validated internally and externally by NASA and independent experts," said Huntress.

Because of the very dim sunlight at Saturn's orbit, Cassini could not conduct its mission to Saturn on solar power. Electrical power is supplied to Cassini by a set of radioisotope thermoelectric generators (RTGs) which convert the heat from the natural decay of plutonium. RTGs have been used on 23 previous U.S. missions. Plutonium dioxide also is used in 117 radioisotope heater units placed on Cassini and Huygens to keep electronics systems at their operating temperatures. These units were most recently used on the Mars Pathfinder mission's Sojourner rover to keep the system from failing during cold Martian nights.

The mission is named for two 17th century astronomers: Italian-French astronomer Jean-Dominique Cassini made several key discoveries about Saturn, and Dutch scientist Christian Huygens discovered Titan.

Development of the Huygens probe was managed by an ESA team located at the European Space Technology and Research Center (ESTEC) in Noordwijk, The Netherlands. The Cassini orbiter was designed, developed and assembled at NASA's Jet Propulsion Laboratory (JPL), located in Pasadena, CA. JPL is a division of the California Institute of Technology. The overall mission is managed by JPL for NASA's Office of Space Science, Washington, DC.

-end-

News Release

National Aeronautics and
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For Release

September 4, 1997

RELEASE: 97-191

HUBBLE REVEALS HUGE CRATER ON THE SURFACE OF THE ASTEROID VESTA

Astronomers have used NASA's Hubble Space Telescope to discover a giant impact crater on the asteroid 4 Vesta. The crater is a link in a chain of events thought responsible for forming a distinctive class of tiny asteroids as well as some meteorites that have reached the Earth.

The giant crater is 285 miles across, which is nearly equal to Vesta's 330 mile diameter. If Earth had a crater of proportional size, it would fill the Pacific Ocean basin. Astronomers had predicted the existence of one or more large craters, reasoning that if Vesta is the true "parent body" of some smaller asteroids, then it should have the wound of a major impact that was catastrophic enough to knock off big chunks. The observations are described in the Sept. 5 issue of Science Magazine.

"In hindsight we should have expected finding such a large crater on Vesta," says Peter Thomas of Cornell University, Ithaca, NY. "But it's still a surprise when it's staring you in the face." Another surprising finding is that such a large crater, relative to Vesta's size, might have been expected to cause more damage to the rest of the minor planet.

"This is a unique opportunity to study the effects of a large impact on a small object," says Michael Gaffey of Rensselaer Polytechnic Institute, Troy, NY. "This suggests that more asteroids from the early days of the solar system may still be intact."

-more-

The collision gouged out one percent of the asteroid's volume, blasting over one-half million cubic miles of rock into space. This tore out an eight-mile deep hole that may go almost all the way through the crust to expose the asteroid's mantle (Vesta is large enough to be differentiated like Earth -- with a volcanic crust, core and mantle, making it a sort of "mini-planet".)

Because of the asteroid's small diameter and low gravity, the crater resembles smaller craters on the Moon that have a distinctive central peak. Towering eight miles, this cone-shaped feature formed when molten rock "sloshed" back to the bullseye center after the impact.

One clue for a giant crater came in 1994 when Hubble pictures showed that one side of Vesta's football shape appeared flattened. "We knew then there was something on Vesta that was unusual," says Thomas.

The astronomers had to wait for a better view from Hubble when Vesta made its closest approach to Earth in a decade, in May 1996, when the asteroid was 110 million miles away.

A total of 78 Wide Field Planetary Camera 2 pictures were taken. The team then created a topographic model of the asteroid's surface by noting surface irregularities along the limb and at the terminator (day/night boundary) where shadows are enhanced by the low Sun angle.

The immense crater lies near the asteroid's south pole. This is probably more than coincidental, say researchers. The excavation of so much material from one side of the asteroid would have shifted its rotation axis so that it settled with the crater near one pole.

Unlike some other large asteroids that have jumbled surfaces due to the asteroids' breakup and recollapse, the rest of Vesta's surface is largely intact, despite the cataclysm. This is based on previous measurements showing it has a surface of basaltic rock -- frozen lava -- which oozed out of the asteroid's presumably hot interior shortly after its formation 4.5 billion years ago, and has remained largely intact ever since.

Approximately six percent of the meteorites that fall to Earth are similar to Vesta's mineralogical signature, as indicated by their spectral characteristics. Vesta's spectrum is unique among all the larger asteroids. The crater may be the ultimate source of many of these meteorites.

Most meteorites are believed to come from other asteroids, but their specific objects of origin cannot be determined in most cases. Thus the distinctive mineralogical makeup of these meteorites means that Vesta is the only world other than the Earth, the Moon and Mars, for which scientists have samples of specifically known origin.

A mystery has been that the meteorites could not have traveled directly from Vesta because at Vesta's location in the asteroid belt, there are no perturbing gravitational forces that would cause pieces to fall into orbits intersecting the inner planets like apples shaken out of a tree. However, Vesta's "daughter" asteroids -- literally "chips off the block" which have color characteristics similar to Vesta -- are near a "chaotic zone" in the asteroid belt where Jupiter's gravitational tug can redirect fragments into orbits that intersect Earth's orbit.

A good determination of the shape of Vesta was necessary for the next step in interpretation, which will use multi-color images of Vesta obtained with Hubble to study the detailed mineralogy of surface regions, including the region of the giant crater. Also, a team led by Don McCarthy of the University of Arizona plans to obtain additional images of Vesta at longer wavelengths this fall using the new Near Infrared and Multi-Object Spectrometer science instrument onboard Hubble.

Members of the Vesta research team are Principal Investigator Ben Zellner of Georgia Southern University; the Co-Investigators are Richard Binzel, MIT; Michael Gaffey, Rensselaer Polytechnic Institute; Alex Storrs, Space Telescope Science Institute; Peter Thomas, Cornell University, and Dr. Ed Wells, Computer Sciences Corporation.

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc., for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency.

-end-

EDITOR'S NOTE: An image to accompany this release is available to news media representatives by calling the Headquarters Imaging Branch at 202/358-1900. Photo number is:

Color: 97-HC-616

Image files in GIF and JPEG format and captions may be accessed on the Internet via anonymous ftp from oposite.stsci.edu in /pubinfo.

		GIF	JPEG
PRC97-27	Vesta	gif/vesta3.gif	jpeg/vesta3.jpg

Higher resolution digital versions (300 dpi JPEG) of the release photograph are available in /pubinfo/hrtemp: 97-27.jpg (color) and 97-27bw.jpg (black & white).

GIF and JPEG images, captions and press release text are available via the World Wide Web at:
http://oposite.stsci.edu/pubinfo/PR/97/27.html
and via links in http://oposite.stsci.edu/pubinfo/Latest.html or
http://oposite.stsci.edu/pubinfo/Pictures.html.

News Release

National Aeronautics and
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Ray Castillo
Headquarters, Washington, DC
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For Release
September 5, 1997

NOTE TO EDITORS: N97-64

RECONSIDERING SPUTNIK: FORTY YEARS SINCE THE SOVIET SATELLITE

NASA's Office of Policy and Plans/History Office will co-sponsor a symposium on September 30 - October 1, 1997, to examine the impact of Sputnik. Speakers will include Sergei Khrushchev, a professor of international studies at Brown University and Nikita Khrushchev's son, and Eileen Galloway, one of the Congressional staff members involved in NASA's creation.

On Oct. 4, 1957, the Soviet Union lofted the first artificial satellite, *Sputnik 1*, into Earth orbit. This 184-pound, basketball-sized sphere ushered in the era of the space race. At the height of the Cold War and several months into the International Geophysical Year, the Soviet Union had beaten the United States into space, a symbolically significant achievement. In the aftermath, the American public was greatly distressed, and the government created the National Aeronautics and Space Administration within a year.

The symposium will be sponsored by the NASA Headquarters Office of Policy and Plans/History Office, the Smithsonian's National Air and Space Museum, the George Washington University Space Policy Institute, and the Kennan Institute for Advanced Russian Studies. Separate panels will address Soviet and American activities prior to Sputnik, the immediate ramifications of its launch in the United States and around the world, and some of the long-term consequences.

The symposium will take place in the auditorium of the S. Dillon Ripley Center of the Smithsonian Institution at 1000 Jefferson Drive SW, Washington, DC, beginning at 9:00 am EDTeach morning. Attendance at the symposium is open to the public but seating is limited and early registration is strongly encouraged. There will be a $30 registration fee.

Media representatives wishing to cover the proceedings can arrange to attend by calling Sandie Horton at 301/220-1701 ext. 23.

For further information and updates on the symposium, please check the World Wide Web at http://www.hq.nasa.gov/office/pao/History/sputconf.htm.

-end-

Video Advisory

National Aeronautics and
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For Release
September 5, 1997

Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

VIDEO ADVISORY: V97-87

HUBBLE: CRATERS ROCK ON VESTA

Today's video feed features animation of a huge impact crater on the asteroid Vesta discovered by astronomers using NASA's Hubble Space Telescope. The giant crater could have led to a series of tiny asteroids and possibly some meteorites that have fallen to Earth.

ITEM 1: HUGE CRATER ON VESTA
Animation of the asteroid Vesta.

For more information contact Donald Savage at (202) 358-1547.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

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For Release

September 5, 1997

RELEASE: 97-192

ASTRONAUT ANDREW ALLEN RETIRES FROM NASA

Three-time Shuttle astronaut Andrew Allen (Lt. Col., USMC) will retire from NASA on Oct. 1 to become president of the FIRST Foundation, Manchester, NH.

The FIRST Foundation works with youth to foster their interest in science and engineering.

"I'm certain that Andy will find creative ways to challenge young people and develop their interest in science and engineering," said David C. Leestma, director of Flight Crew Operations. "We wish him all the best in this new venture."

Allen is a veteran of three space flights, having flown as pilot on STS-46 in 1992 and STS-62 in 1994. He was commander for STS-75, the second Tethered Satellite System mission in 1996.

"I am truly thankful and have enjoyed my experiences at NASA and will miss the people I have been privileged to work with," Allen said. "I hope this new challenge will give some young people the same opportunities I have had in my life."

For complete biographical information on Allen, or any astronaut, see the NASA Internet biography home page at URL:

http://www.jsc.nasa.gov/Bios/

- end -

News Release

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For Release

September 9, 1997

NOTE TO EDITORS: N97-65

BRIEFINGS SET FOR NEXT SHUTTLE-MIR DOCKING MISSION

A series of briefings on the next flight of the Shuttle Atlantis to link up to the Russian space station Mir will be held at NASA's Johnson Space Center (JSC), Houston, TX, on Tuesday, Sept. 16. The briefings will be broadcast live on NASA Television.

The seventh Shuttle mission of 1997, STS-86 is targeted for launch around Sept. 25.

The briefings will begin on Sept. 16 at 9 a.m. EDT (all times listed are EDT) with an overview of the Shuttle-Mir Phase One Program, followed at 10:30 a.m. with the mission overview briefing, conducted by STS-86 Lead Flight Director Paul Dye. A Spacehab briefing will follow at 11:30 a.m., before the STS-86 briefings take a break for the airing of the NASA TV Video File at noon. A briefing on the spacewalk planned for STS-86 will begin at 1 p.m., followed by the STS-86 crew news conference at 2:30 p.m.

Individual round-robin interviews with the STS-86 astronauts will be held after the crew news conference for reporters attending the briefing at JSC and for those who make special arrangements in advance to conduct the interviews by phone. NOTE: Reporters interested in round-robin interviews with the STS-86 astronauts should fax a letter of interest to Eileen Hawley at JSC Public Affairs by close of business on Sept. 12. The fax number for the JSC Public Affairs office is 281/483-2000.

The round-robin interviews will not be seen on NASA TV. NASA Television is available through the GE2 satellite system which is located on Transponder 9C, at 85 degrees West longitude, frequency 3880.0 MHz, audio 6.8 Mhz.

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STS-86 PRE-FLIGHT BRIEFINGS
Tuesday, Sept. 16, 1997
(All times listed are Eastern)

9 a.m. - 10:30 a.m. Phase One Overview

•Frank Culbertson, Director, Shuttle-Mir Phase One Program
•Valery Ryumin, Director, RSC Energia, Phase One Program
•John Uri, Mission Scientist

10:30 a.m. - 11:30 a.m. Mission Overview
Paul Dye, STS-86 Lead Flight Director

11:30 a.m. - noon Spacehab
Mike Bain, Shuttle-Mir Program Manager, Spacehab

NASA Video File noon - 12:45 p.m.

1 p.m. - 2 p.m. Spacewalk Briefing
Jerry Miller, STS-86 EVA Officer

2:30 p.m. - 3:30 p.m. Crew News Conference
James Wetherbee, Commander; Michael Bloomfield, Pilot; Vladimir Titov, Mission Specialist 1; Scott Parazynski, Mission Specialist 2; Jean-Loup Chretien, Mission Specialist 3; Wendy Lawrence, Mission Specialist 4; David Wolf, Mission Specialist 5.

3:45 p.m. STS-86 crew one-on-one interviews (Not seen on NASA TV)

News Release

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Headquarters, Washington, DC
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For Release
September 9, 1997

Franklin O'Donnell / Diane Ainsworth
Jet Propulsion Laboratory, Pasadena, CA
(Phone: 818/354-5011)

NOTE TO EDITORS: N97-66

MARS GLOBAL SURVEYOR ARRIVAL EVENTS LIVE ON NASA TV

Operations in support of the arrival of NASA's Mars Global Surveyor (MGS) spacecraft in orbit around the red planet on Sept. 11 will be shown live this week on NASA Television. The propulsion system aboard MGS was pressurized successfully earlier today in preparation for this event.

Coverage of the key events on arrival day, Thursday, Sept. 11, will begin at 8 p.m. EDT with a status briefing originating from the Jet Propulsion Laboratory (JPL), Pasadena, CA. A signal indicating the start of the 22-minute burn of the main rocket engine on MGS should be received on Earth at 9:31 p.m. EDT. A post-engine burn news briefing is scheduled for approximately 10:40 p.m. EDT.

Mission coverage will feature live commentary and views of mission control rooms at JPL and at Lockheed Martin Astronautics Corp., Denver, CO.

Daily status briefings on preparations for the orbital arrival of MGS will be presented live on NASA TV from JPL at 1 p.m. EDT on Wednesday, Sept. 10, and Thursday, Sept. 11.

Working in partnership with the Mars Pathfinder lander, MGS represents the beginning of a sustained series of robotic missions to Mars over at least the next decade. The spacecraft carries six scientific instruments designed to provide a comprehensive map of the surface, atmosphere and interior. The two-year science mission of MGS is scheduled to begin in March 1998 following four months of orbital dips through the upper atmosphere of Mars to reach the mapping orbit in a process called aerobraking.

NASA Television is located on GE-2, transponder 9C at 85 degrees West longitude, vertical polarization, with a frequency of 3880 Mhz, and audio of 6.8 Mhz. News media representatives can call 818/354-6170 for an audio feed of the briefings.

-end-

News Release

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For Release
September 10, 1997

David Morse / Michael Mewhinney
Ames Research Center, Moffett Field, CA
(Phone: 650/604-4724 or 604-9000)

RELEASE: 97-193

LAUNCH OF LUNAR PROSPECTOR RESCHEDULED FOR LATE NOVEMBER

Launch of NASA's Lunar Prospector mission to explore the Moon has been rescheduled from late September to Nov. 23, 1997.

The schedule change occurred because additional time is needed to complete testing and preparation of the new Lockheed Martin LMLV2 launch vehicle.

Lunar Prospector is the first competitively selected venture in NASA's Discovery Program series of "faster, better, cheaper" space science exploration missions. The entire mission, including the 660-pound spacecraft, its launch vehicle, science instruments and data operations and delivery, has been developed at a total cost of $62.8 million.

Following its launch and cruise to the Moon, Lunar Prospector will orbit above the Moon's surface at an altitude of approximately 63 miles during a one-year mapping mission. Its five science instruments will provide detailed data on the composition and gravity field of the entire lunar landscape, of which more than 75 percent remains virtually unexplored. One key mission objective is to provide direct evidence of the presence or absence of ice in the shaded regions of the lunar poles.

The Lunar Prospector mission is being managed by NASA's Ames Research Center, Moffett Field, CA, through a prime contract with Lockheed Martin Corporation, Sunnyvale, CA. The launch vehicle is being provided by Lockheed Martin Astronautics, Denver, CO, as part of the prime contract. The launch will occur from Launch Complex 46 on Cape Canaveral Air Station, FL.

Initially scheduled for Sept. 24, 1997, the Lunar Prospector launch was delayed by the prior launch of NASA's Lewis spacecraft on an LMLV1 launch vehicle. That launch was accomplished successfully on Aug. 23, although later problems developed with the Lewis spacecraft itself. A successful launch of the LMLV1 was a necessary step before the first use of the LMLV2. The principal difference between the two versions of the LMLV launch vehicle is the addition of an extra Castor 120 solid rocket motor.

-more-

Further information on Lunar Prospector, including still imagery, is available on the Internet at the following URL:

http://pyroeis.arc.nasa.gov/lunar_prospector/home.html

- end -

News Release

National Aeronautics and
Space Administration

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For Release

September 11, 1997

RELEASE: 97-194

NASA, DOD AND FAA SIGN JOINT AGREEMENT ON SPACEPORTS LAUNCH GUIDANCE

The NASA Administrator, the Under Secretary of Defense for Acquisition and Technology (DOD) and the Federal Aviation Administration (FAA) Administrator have signed a joint Memorandum of Agreement (MOA) that provides guidance for federal interaction with commercial launch site operators on spaceports.

This joint agreement brings to fruition many months of concerted effort by the members of the Interagency Working Group on Spaceports, which was initiated at the request of the White House Office of Science and Technology Policy.

A "spaceport" will be similar to an airport for rockets and will be managed by a launch site operator. Operation of a launch site consists of operations and maintenance of launch property, which must include at least one launch pad. These operators may be state government agencies, state-chartered or-sponsored entities, or commercial organizations.

The primary objective of the MOA is to facilitate and encourage access by the private sector and state and local governments to excess federal launch property and services.

The MOA explains the respective roles and responsibilities of federal agencies in general, and specifically NASA, DOD and FAA, in their interactions with launch site operators. The intent is to minimize the regulatory burden on the U.S. commercial space sector by clearly delineating federal agency requirements and oversight responsibilities, eliminating overlap and duplication.

The guidance applies to current and prospective FAA-licensed launch site operators on, or outside, federal installations. It does not apply to operation of a launch site performed as part of a federal space activity carried out by, or for, the federal government.

-more-

The basis of a federal license is the obligation to protect public health and safety. Federal guidance is provided in several areas:

- -Environmental and safety compliance
- -Licensing of launch site operators
- -Financial responsibility and allocation of risk requirements applicable to activities conducted on a federal installation
- -Federal agency pricing for launch property and services
- -Foreign involvement in operation of a launch site
- -State government-related launch site operators, and
- -Real property.

NASA, DOD, and FAA plan to use this agreement as a basis for writing implementing procedures to carry out their respective responsibilities in interacting with launch site operators.

-end-

News Release

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For Release

September 11, 1997

RELEASE: 97-195

LAWRENCE TO LEAVE NASA

Jeff Lawrence, NASA's Associate Administrator for Legislative Affairs, will be leaving NASA at the end of September to pursue a career in the private sector.

Lawrence has served as the agency's top-ranking legislative official since April 19, 1993. He will join Cassidy and Associates as a senior vice president.

"Jeff's tireless efforts, commitment and dedication have benefited not only NASA and Congress, but also our nation's space program," said NASA Administrator Dan Goldin. "Through Jeff's leadership, NASA has developed strong, bipartisan support and an effective rapport with Congress. It truly has been an honor working with him."

Ed Heffernan, NASA's White House liaison, will serve as acting Associate Administrator for Legislative Affairs until a replacement is named.

"I'm certain Jeff's many talents and sense of public duty will serve him as well in his new endeavors as they always have in his 25 years of service to local, state and federal communities," said Goldin.

Before joining NASA, Lawrence served at George Washington University as special assistant for Federal Affairs, serving as an advisor to the president, faculty and administration. He also has extensive experience on Capitol Hill, serving as legislative director for former Congressman Bill Green (R-NY), legislative assistant to Senator Daniel K. Akaka (D-HI), when Akaka was a member of the House, and to former Congressman Norman E. D'Amours (D-NH).

A 1972 graduate of Colby College in Waterville, ME, Lawrence taught English and history and coached track in Kittery, ME. In 1990 and 1992, he received awards from the Council of Large Public Housing Authorities for service to low-income housing residents. In 1987, he was selected to participate in an exchange program between the U.S. Congress and the West German Bundestag.

Lawrence is married to the former Lynne Des Jardins. They have two children.

-end-

Video Advisory

National Aeronautics and
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For Release
September 12, 1997

VIDEO ADVISORY: V97-88

HEART-TO-HEART EXAMINATION; AXAF CENTER OPENS

Today's video feed features footage of a "patient" undergoing an sonogram of his heart at NASA's Lewis Research Center in Cleveland, Ohio, while being diagnosed "remotely" by NASA scientists at Ames Research Center in Moffett Field, California. Also on NTV is animation and b-roll of the Advanced X-Ray Astrophysics Facility (AXAF) whose Operations Control Center opens today at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts.

ITEM 1: HEARTS ACROSS AMERICA
ITEM 1a: ECHOCARDIOGRAPHY NETWORK
ITEM 1b: INTERVIEW - DAVE FOLTZ, NETWORKING PROJECT MANAGER, NASA LEWIS RESEARCH CENTER
ITEM 1c: INTERVIEW - JAMES D. THOMAS, DIRECTOR, CARDIOVASCULAR IMAGING, CLEVELAND CLINIC FOUNDATION
ITEM 1d: INTERVIEW - CHRISTINE FALSETTI, NASA RESEARCH EDUCATION PROJECT MANAGER, AMES RESEARCH CENTER

For more information contact Don Nolan-Proxmire at (202) 358-1983 or Sally Harrington on (216) 433-2037.

ITEM 2: SEARCHING FOR COSMIC VIOLENCE
Animation and b-roll of AXAF.
ITEM 2a: INTERVIEW - DR. HARVEY TANANBAUM, DIRECTOR, ADVANCED X-RAY ASTROPHYSICS FACILITY SCIENCE CENTER
ITEM 2b: INTERVIEW - DR. HARVEY GOLDEN, NASA MANAGER, MARSHALL SPACE FLIGHT CENTER

For more information contact Donald Savage at (202) 358-1547 or Dave Drachlis on (205) 544-0034.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

News Release

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For Release

September 12, 1997

RELEASE: 97-196

VETERAN SHUTTLE COMMANDER RETIRES

Shuttle astronaut and Russian space station Mir veteran, John Blaha (Col., USAF Ret.), will retire from NASA on Sept. 26 to become the Assistant Vice President, Integration Engineering, for USAA Corporation in San Antonio, TX.

"John has been a valuable member of the astronaut office throughout his career," said David C. Leestma, director of Flight Crew Operations. "We wish him the best of luck as he pursues these new opportunities."

Selected as an astronaut in 1980, Blaha has extensive flight experience, having flown on six separate Shuttle missions during his career. He was the pilot aboard Discovery for the STS-29 mission in March 1989, and flew again on Discovery as pilot for STS-33 in Nov. 1989. Blaha commanded two Shuttle missions, STS-43 in Aug. 1991 aboard Atlantis and STS-58 on Columbia in Nov. 1993.

Following extensive training at the Gagarin Cosmonaut Training Center outside Moscow, Blaha was named as an extended duration crew member to fly on the Mir space station. He launched to Mir as a member of the STS-79 crew in Sept. 1996 and returned to Earth on Atlantis with the STS-81 crew in Jan. 1997, after completing a four-month stay on Mir.

"Brenda and I have thoroughly enjoyed the past 17 years with NASA," Blaha said. 'We are looking forward to our new opportunity in San Antonio. We appreciate all the support we have received over the years."

For complete biographical information on Blaha, or any astronaut, see the NASA Internet biography home page at URL: http://www.jsc.nasa.gov/Bios/

-end-

News Release

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Michael Mewhinney
Ames Research Center, Moffett Field, CA
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Rob Whitehouse
The Cleveland Clinic
(Phone: 216/444-8927)

For Release

September 12, 1997

RELEASE: 97-197

SPACE STATION TECHNOLOGY WILL BRING EXPERT MEDICAL CARE TO REMOTE AREAS ON EARTH

Soon people who do not live in or near large cities with major medical facilities will have expert medical care readily available. Patients in remote or medically underserved areas of the country will benefit from an experiment in advanced telemedicine conducted jointly by NASA's Lewis Research Center, Cleveland, OH, and Ames Research Center, Moffett Field, CA, and James D. Thomas, M.D., FACC, of The Cleveland Clinic Foundation, Cleveland, OH.

Recently, a "patient" undergoing an echocardiographic examination at Lewis was "remotely" diagnosed by Dr. Thomas at Ames. He viewed a real-time display of echocardiographic video images transmitted over the broadband NASA Research and Education Network (NREN). Dr. Thomas interactively guided the technician administering the procedure through a two-way voice link between the two sites.

"I was very pleased with the diagnostic quality of the echocardiograms," said Dr. Thomas. "Digital echocardiographic equipment will be on the International Space Station when it is operational. Echocardiography is more practical for life in space than other imaging techniques, such as magnetic resonance imaging (MRI) because it requires less power, is noninvasive, is small and versatile, and is not magnetic or radioactive. The early results of our experiment support our belief that this technology holds great promise for use in space as well as use on Earth by means of telemedicine."

-more-

Echocardiography is a medical technique that applies the methods of ultrasound imaging to the cardiac system, providing a "motion picture" of the heart in action. A small, rural clinic may have access to an echocardiograph machine but not to a technician specially trained in its operation, or to a staff cardiologist. If the clinic were connected to a major metropolitan medical facility through a high-speed communications network, a minimally trained technician could carry out the procedure under the supervision and guidance of qualified echocardiography personnel.

While many telemedicine requirements can be satisfied by the transmission of still images (e.g., X-ray photographs), the challenge of procedures such as echocardiography is that high-resolution, moving images must be transmitted in real time. This requires a reliable broadband network and a robust data-compression mechanism.

"In the demonstration, we used the NREN to assess the clinical feasibility of conducting remote echocardiography, as well as the technical feasibility of supporting remote echocardiography, by determining the minimum network needed and the maximum video compression required to produce a transmission of high-resolution medical imagery," said Christine Falsetti, NREN project manager at Ames.

The NASA Research and Education Network is NASA's cornerstone project of the interagency Next Generation Internet (NGI) Initiative. In Oct. 1996, President Clinton and Vice President Gore announced their commitment to the NGI initiative based upon the strong research and development programs across Federal agencies.

"This experiment was a step toward reaching the goals of the NGI," said David A. Foltz, networking project manager at Lewis. "Pushing current networking technologies to the limit helps us understand how to design, build and operate a national communications network for the future."

Reaching these goals will affect health care on Earth and will pave the way for physicians on Earth to view the heart function of an astronaut aboard the International Space Station.

During the experiment, Lewis provided network engineering staff and hardware support to Dr. Thomas, while Ames provided overall network management of the NREN and related technical support to Lewis personnel. The Cleveland Clinic Foundation provided echocardiograph equipment and support personnel used to examine the volunteer "patient" at Lewis.

This experiment is a part of the cooperative agreement involving a two-year, $4 million grant to support the research and development of a digital echocardiography lab at The Clinic, that NASA announced earlier this year.

-end-

News Release

National Aeronautics and
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For Release

September 12, 1997

RELEASE: 97-198

REPAIR WORK ON CASSINI HUYGENS PROBE COMPLETED SUCCESSFULLY

Engineers at Kennedy Space Center, FL, have completed repairs to damaged thermal insulation on the European Space Agency's Huygens probe, a part of the Cassini mission to Saturn. Based on the amount of time needed to return the spacecraft to the pad from a spacecraft checkout facility and complete the work necessary to be ready for launch, NASA managers have set a tentative launch date of no earlier than Oct. 13. The launch date will be confirmed by the Air Force after the spacecraft has been mated to the Titan IV/Centaur next week.

On Sept. 7, the spacecraft was removed from atop the Air Force Titan IV rocket at Space Launch Complex 40 to repair the insulation inside the Huygens probe. Damage was caused by a higher-than-acceptable flow rate from the air conditioning to the inside of the probe.

To make the probe ready for launch again, engineers detached and disassembled the Huygens probe from the Cassini orbiter. Upon inspection, the damage was found to be limited to a few square inches of foam and Kapton insulation. The damaged material was removed and the insulation repaired.

The Huygens probe has now been retested and reassembled. Closeouts are under way today in preparation for mating the probe once again to the Cassini orbiter on Saturday.

- end -

News Release

National Aeronautics and
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For Release

September 12, 1997

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RELEASE: 97-199

ATLANTIS' SEVENTH MISSION TO MIR SET FOR SEPT. 25

Space Shuttle Program managers today unanimously approved plans for a September 25 launch of the seventh shuttle mission to rendezvous and dock with Russia's Mir Space Station to deliver supplies and return Mike Foale from the outpost following his four month stay.

"Our review today shows that the processing and training teams have done an exceptional job in getting Atlantis and crew ready for this mission," said George Abbey, Director of the Johnson Space Center, who chaired the Flight Readiness Review at the launch site in Florida.

Astronaut Dave Wolf has completed training and is scheduled to replace Michael Foale for a four-month stay on Mir to continue the permanent U.S. presence on the station that began with Shannon Lucid on the STS-76 mission in 1996.

The launch window opens at 10:34 p.m. EDT and closes about 7 minutes later at 10:41 p.m. Following a nominal flight duration of 9 days, 20 hours, 24 minutes, Atlantis is scheduled to land at the Kennedy Space Center, Florida at about 6:58 p.m. EDT, October 5.

In addition to Foale and Wolf, Atlantis' crew includes Commander Jim Wetherbee, Pilot Mike Bloomfield and Mission Specialists Scott Parazynski, Wendy Lawrence, Jean-Loup Chretien and Vladimir Titov. Parazynski and Titov will conduct a spacewalk to retrieve some science experiments from the outside of the station.

STS-86 will be Atlantis' 20th mission into space and the 87th shuttle flight in the program's history. -

-end -

Video Advisory

National Aeronautics and
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For Release
September 15, 1997

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VIDEO ADVISORY: V97-89

EL NIÑO: I'M BACK!!!

Today's video feed features animation of ocean circulation and atmospheric water vapor taken from two Earth-orbiting satellites that prove the weather-disrupting phenomenon known as El Niño is back.

ITEM 1: EL NIÑO IS BACK AND STRONG
Animation of El Niño.

For more information contact Doug Isbell at (202) 358-1753 or Mary Hardin (818) 354-5011.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
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For Release

September 15, 1997

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RELEASE: 97-200

INDEPENDENT NASA SATELLITE MEASUREMENTS CONFIRM EL NINO IS BACK AND STRONG

Pacific Ocean sea-surface height measurements and atmospheric water vapor information taken from two independent Earth-orbiting satellites are providing more convincing evidence that the weather-disrupting phenomenon known as El Niño is back and strong.

"The new data collected since April 1997 confirm what we had earlier speculated upon and what the National Oceanic and Atmospheric Administration (NOAA) has predicted -- a full-blown El Niño condition is established in the Pacific," said Dr. Lee-Lueng Fu, project scientist for the U.S./French satellite TOPEX/POSEIDON satellite at NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA.

The five years of global ocean topography observations made by TOPEX/POSEIDON have been a boon for El Niño researchers, who have been able to track three El Niño events since the satellite's launch in August 1992.

"The recent data are showing us that a large warm water mass with high sea-surface elevations, about six inches (15 centimeters) above normal, is occupying the entire tropical Pacific Ocean east of the international date line. In fact, the surface area covered by the warm water mass is about one-and-a-half times the size of the continental United States," Fu said. "We watched this warm water mass travel eastward from the western Pacific along the equator earlier this spring. Right now, sea-surface height off the South American coast is 10 inches (25 centimeters) higher than normal, which is comparable with the conditions during the so-called 'El Niño of the century' in 1982-83."

-more-

In addition, recent atmospheric water vapor data collected from NASA's Upper Atmosphere Research Satellite (UARS) show tell-tale signs of an El Niño condition in the tropical Pacific Ocean.

"The Microwave Limb Sounder experiment on UARS is detecting an unusually large build-up of water vapor in the atmosphere at heights of approximately eight miles (12 kilometers) over the central-eastern tropical Pacific. Not since the last strong El Niño winter of 1991-92 have we seen such a large build-up of water vapor in this part of the atmosphere," said JPL's Dr. William Read. "Increased water vapor at these heights can be associated with more intense wintertime storm activity from the 'pineapple express,' a pattern of atmospheric motions that brings tropical moisture from Hawaii to the southwestern United States. This phenomenon is an example of how the ocean and atmosphere work together to dictate the severity of El Niño events."

An El Niño is thought to be triggered when steady westward blowing trade winds weaken and even reverse direction. This change in the winds allows the large mass of warm water that is normally located near Australia to move eastward along the equator until it reaches the coast of South America. This displaced pool of unusually warm water affects evaporation, where rain clouds form and, consequently, alters the typical atmospheric jet stream patterns around the world. The change in the wind strength and direction also impacts global weather patterns.

In May, NOAA issued an advisory regarding the presence of the early indications of El Niño conditions. Subsequent El Niño forecast activities supported by NOAA indicate the likelihood of a moderate or strong El Niño in late 1997. The forecast model operated at NOAA's National Centers for Environmental Prediction used data collected by the TOPEX/POSEIDON satellite.

"The added amount of oceanic warm water near the Americas, with a temperature between 70-85 degrees Fahrenheit, is about 30 times the volume of water in all the U.S. Great Lakes combined," said Dr. Victor Zlotnicki, a TOPEX/POSEIDON investigator at JPL. "The difference between the current, abnormally high amount of heat in the near-surface waters and the usual amount of heat in the same area is about 93 times the total energy from fossil fuels consumed by the United States in 1995."

On-going NOAA advisories on El Niño conditions are available on the Internet at the following URL:

http://nic.fb4.noaa.gov:80/products/analysis_monitoring/ensostuff/index.html

The climatic event has been given the name El Niño, a Spanish term for a "boy child," because the warm current first appeared off the coast of South America around

Christmas. Past El Niño events have often caused unusually heavy rain and flooding in California, unseasonably mild winters in the Eastern United States and severe droughts in Australia, Africa and Indonesia. Better predictions of extreme climate episodes like floods and droughts could save the United States billions of dollars in damage costs. El Niño episodes usually occur approximately every two to seven years.

Developed by NASA and the French Centre National d'Etudes Spatiales (CNES), the TOPEX/POSEIDON satellite uses an altimeter to bounce radar signals off the ocean's surface to get precise measurements of the distance between the satellite and the sea surface. These data are combined with measurements from other instruments that pinpoint the satellite's exact location in space. Every ten days, scientists produce a complete map of global ocean topography, the barely perceptible hills and valleys found on the sea surface. With detailed knowledge of ocean topography, scientists can then calculate the speed and direction of worldwide ocean currents.

The Microwave Limb Sounder instrument was originally designed to study atmospheric ozone depletion, but scientists have devised new ways of using the data to study atmospheric water vapor. The Upper Atmosphere Research Satellite is completing its sixth year of operation after being designed for only a two-year mission, and is conducting an extended mission of longer-term global monitoring.

The Jet Propulsion Laboratory, a division of the California Institute of Technology, Pasadena, CA, manages the TOPEX/POSEIDON mission and the MLS instrument for NASA's Mission to Planet Earth enterprise, Washington, DC. The UARS satellite is managed by NASA's Goddard Space Flight Center, Greenbelt, MD.

NASA's Mission to Planet Earth is a long-term science research program designed to study the Earth's land, oceans, air, ice and life as a total system.

-end-

News Release

National Aeronautics and
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For Release
September 16, 1997

NOTE TO EDITORS: N97-67

TECHNOLOGY 2007 CONFERENCE TO BE HELD NEXT WEEK IN BOSTON

Media are invited to witness NASA's vision for the Next Generation Internet, expected to be a thousand times faster than today's. These and other innovations that will become the products of tomorrow will be on display at Technology 2007, the eighth annual National Technology Transfer Conference, at the Hynes Convention Center, Boston, MA, Sept. 22-24. Attendees also can don 3D glasses and view a monster 17-foot long panorama of the Martian landscape taken by the Mars Pathfinder mission.

Technology 2007 gives U.S. companies access to the hottest inventions developed by NASA and the other federal labs so they can develop a whole range of new products with down-to-Earth uses. NASA offers access to its 11,000 scientists and engineers to partner with companies in their R&D efforts. Products like the pacemaker, car design software ... even an MRI ... all came from NASA technology.

Convention attendees can explore 80,000 square feet of the latest technology innovations emanating from NASA, federal laboratories, their contractors, state organizations, universities and private companies at the annual business event. It will be held from 10 a.m. to 4 p.m, EDT, Sept. 22-23 and from 10 a.m. to 3 p.m. on Sept. 24. Media representatives can reach NASA personnel at the convention by pager at 1-800-417-0968. For registration information, please call 508-790-3200.

Demonstration of a new Internet -- a thousand times faster and more reliable than today's -- for 21st century researchers is the subject of a plenary session speech to be given by NASA's Christine Falsetti. More information can be obtained on the researchers' Internet page at URL:

http://www.ngi.gov

More information about Technology 2007 can be obtained by telephoning the Technology Utilization Foundation at 212/490-3999. The Technology 2007 website is at URL:

www.abptuf.org/T2007

People can learn more about NASA inventions by calling 1-800-678-6882 or by accessing the NASA Commercial Technology Network web page at URL:

http://nctn.hq.nasa.gov/nctn/

-end-

Video Advisory

National Aeronautics and
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For Release
September 16, 1997

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VIDEO ADVISORY: V97-90

STS-86: SHUTTLE-MIR DOCKING MISSION; WOLF TRAINING

Today's video feed features animation of the next flight of Space Shuttle Atlantis, STS-86, which is scheduled for launch on September 25. Also on NTV is footage of Astronaut David Wolf training for a four-month stay on space station Mir.

ITEM 1: STS-86
Animation of STS-86.

ITEM 2: WOLF TRAINING
Footage shows Astronaut David Wolf training in the hydro laboratory at the Gagarin Cosmonaut Training Center in Star City, Russia.

For more information contact Rob Navias at (281) 483-5111.

ITEM 3: REPLAY- EL NIÑO IS BACK AND STRONG

For more information contact Doug Isbell at (202) 358-1753 or Mary Hardin (818) 354-5011.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

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For Release

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September 16, 1997

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RELEASE: 97-201

HUBBLE STAYS ON TRAIL OF FADING GAMMA-RAY BURST FIREBALL, RESULTS POINT TO EXTRAGALACTIC ORIGIN

New Hubble Space Telescope observations of the ever-fading fireball from one of the universe's most mysterious phenomena -- a gamma-ray burst -- is reinforcing the emerging view that these titanic explosions happen far away in other galaxies, and so are among the most spectacularly energetic events in the universe.

The most recent finding from observations with Hubble's Imaging Spectrograph made on Sept. 5 -- nearly six months after the blast -- is being reported today at the Fourth Huntsville Symposium on Gamma Ray Bursts, at NASA's Marshall Space Flight Center, Huntsville, AL.

"Hubble is the only telescope capable of continuing to watch the aftermath of this explosion, because it has faded to 1/500th its brightness when first discovered by ground-based telescopes last March," says Andrew Fruchter of the Space Telescope Science Institute in Baltimore, MD. "These observations provide an unprecedented opportunity to better understand the catastrophe behind such incredible outbursts."

- more -

Hubble's key findings:

1. The continued visibility of the burst, and the rate of its decline over time, support theories that produce the light from a gamma-ray burst in a "relativistic" fireball (expanding at nearly the speed of light) located at extragalactic distances. A burst in our galaxy, at the observed brightness, would have been slowed by the interstellar medium within the first few weeks and faded from sight by now.

2. The observations contradict earlier claims, by some astronomers, that the gamma-ray burst is moving against the sky background (this offset is called proper motion). Had proper motion been detected, the gamma-ray burst would have had to be no farther than about 30,000 light years, or about the distance to the center of the galaxy.

3. The fuzzy companion object in which the fireball is embedded -- as first confirmed by Hubble in March 26 observations -- has not noticeably faded. This means it is not a relatively nearby nebula produced by the explosion, but in all likelihood a host galaxy.

4. Since the burst did not occur at the center of the host galaxy, but near its edge, the gamma-ray burst phenomenon is not related to activity in the nucleus of a galaxy. The Hubble observations support the "fireball" model for a gamma-ray burst.

"These observations are consistent with colliding neutron stars creating the fireball, but do not require it. The cause of that fireball is still not determined. Though colliding neutron stars is one theoretical means of producing such a fireball, it is not the only one," says Fruchter.

Hubble observations over the past six months show the fireball is fading at a constant rate, as predicted by theory. Eventually, gas plowed in front of the stellar tidal wave should build up enough resistance to bring the fireball to a halt -- like snow piling up in front of a plow -- and it should blink out. The fact that that hasn't happened yet, however, offers more clues to solving the gamma-ray burst mystery.

If the burst had happened nearby, the resulting fireball should have had only enough energy to propel it into space for a month or so before "hitting the wall" of accumulated gas and dying out. The fact that this fireball has expanded to gargantuan size, sweeping out a bubble of space one light-year across, means the explosion was truly titanic and, to match the observed brightness, must have happened at the vast distances of galaxies.

When Hubble first observed the fireball on March 27 (several weeks after the initial discovery), it was at 26th magnitude. The magnitude scale is used to measure the brightness of objects in space. The lower the magnitude, the brighter the object. The unaided eye can detect objects of the 6th magnitude.

By the Sept. 5 observation it had faded to one-fifth that brightness to 27.7 magnitude (approximately 1/500,000 the brightness of the faintest star). The suspected host galaxy has remained at approximately 25th magnitude.

Only Hubble has the resolution and contrast capability to still distinguish the fading fireball from the now-brighter host galaxy. The researchers hope for follow-up observations to continue keeping track of the burst's optical counterpart until it fades away.

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc. (AURA) for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency (ESA).

- end -

EDITOR'S NOTE: Images to accompany this release are available electronically through the World Wide Web through links at http://www.stsci.edu or directly at URL:

http://oposite.stsci.edu/pubinfo/PR/97/30.html

and via links at URLs:

http://oposite.stsci.edu/pubinfo/Latest.html or
http://oposite.stsci.edu/pubinfo/Pictures.html.
http://oposite.stsci.edu/pubinfo/PR.html

Image files also may be accessed via anonymous ftp from oposite.stsci.edu in /pubinfo: gif/grb0228b.gif (GIF) and jpeg/grb0228b.jpg (JPEG).

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

Michael Braukus
Headquarters, Washington, DC
(Phone: 202/358-1979)

Kyle Herring/Linda Matthews-Schmidt
Johnson Space Center, Houston, TX
(Phone: 281/483-5111)

For Release

September 16, 1997

RELEASE: 97-202

SHUTTLE-MIR PROGRAM READIES FOR NEXT PHASE

With three-fourths of the Shuttle-Mir program nearly complete, science investigators and mission managers are preparing for the next phase of cooperative efforts that will lead to the most ambitious peacetime scientific project ever undertaken -- the International Space Station.

The next phase of Shuttle-Mir includes more planned science experiments than any previous stay by a U.S. astronaut.

"The importance of this program cannot be overestimated," said Shuttle-Mir program manager Frank Culbertson. "This is where theory meets reality, where the practical lessons we learn aboard the Mir are already paying large dividends as we prepare to start construction of the Space Station in less than a year."

The launch of Dr. David Wolf aboard Atlantis next week on the STS-86 mission continues a research program started with Dr. Norm Thagard's stay on Mir in 1995 and includes 35 scientific studies and technology demonstrations spanning six research disciplines. Wolf's flight furthers the continuous U.S. presence in space that began with Shannon Lucid on the STS-76 mission in March 1996.

At the start of Wolf's mission, the total U.S. astronaut time aboard the Mir will be 22 months -- with 18 months of continuous occupancy since March 1996.

Wolf's mission to Mir specifically involves six research disciplines including advanced technology, Earth sciences, fundamental biology, human life sciences, microgravity research and a category for learning the lessons necessary to successfully build the Space Station -- the engineers call it "risk mitigation."

-more-

Despite the June 25 collision of a resupply vehicle with the Mir, most of the research for Wolf's mission will go ahead. The loss of life sciences hardware will be partly offset by the launch of replacement equipment and by new techniques for achieving scientific goals. Following two successful spacewalks, which increased available electricity aboard the Mir, U.S. science operations during Wolf's mission to Mir are not expected to be limited by power.

The investigations from this mission will add to the growing body of results from the program. To date, approximately 120 U.S. scientific studies have been conducted aboard Mir by researchers from the United States, Russia, Canada, France, Germany, Hungary and Japan. Several significant accomplishments from Shuttle-Mir research are described below.

- Of prime importance to the health of crew members and basic research is the monitoring of the Mir's environment. Given time aboard the Mir, station researchers have learned to better monitor vital factors such as air and water quality and radiation levels. These techniques have been validated and will continue to be used on the Space Station. These studies have shown that the Mir environment is safe for crew members, and in the case of occasional temporary incidents, proper monitoring and adequate protective measures are available.

- Studies aboard the Mir have allowed more precise characterization of human physiology and psychology in space, in particular changes in bones and muscles, the neurovestibular system, the risk of developing kidney stones in space, and changes in the interactions among crew members and their ground support team over the course of the mission.

- The space flight-induced changes seen in muscles and bones are similar to those seen in bedridden or osteoporotic patients and characterization of these changes in healthy crew members may lead to better methods of rehabilitation and treatment for patients on Earth. The Shuttle-Mir program has allowed NASA to evaluate the effectiveness of the countermeasures that the Russians have developed over the past 25 years to minimize the effects of long-term weightlessness.

- New techniques and methods have been used to produce protein crystals and other substances, providing both qualitative and quantitative improvements over ground-based and previous space-based experiments. The long-duration nature of this program has allowed researchers to produce some crystals that cannot be grown on the Shuttle or on Earth. Analysis of the higher quality crystals grown on Mir permits better understanding of their molecular structure, leading to better understanding of viral interactions with antibodies, enzyme functions, and possibly new pharmaceutical products.

- Aboard a space station, microgravity experiments are especially sensitive to vibration. A study using new sensors has measured vibration levels of normal work routines and how that may affect experiment processing. The study, begun in 1996 by Shannon Lucid aboard Mir, has measured much lower vibrations on Mir compared with data obtained during the U.S. Skylab program of the 1970s. This information is directly beneficial to the Space Station Program where it is being used to assess the potential impact of crew motion on the microgravity environment.

- The promise of tissue culturing in space has been dramatically advanced by work aboard the Mir. NASA was able to extend the duration of space tissue growth from 10 days to four months, with the successful culturing of cartilage cells in an onboard bioreactor. Wolf was a member of the research team that originally developed the bioreactor design at the Johnson Space Center, Houston, TX.

- On Earth, tissue culturing is largely limited to two dimensions. In the space flight experiment, the tissue grew in a three-dimensional structure more like tissue in a living organism would grow. In addition to the scientific result of the experiment, NASA learned how to upgrade the facility for future use on Mir as well as on the Space Station.

- Growing plants in space is of scientific interest for botanists and future space flight operations. A significant first in this area has been achieved during the Shuttle-Mir program when seeds generated by plants grown in space were planted and germinated to grow new plants -- the first so-called "seed-to-seed" experiment in space. This is a significant development in the ability to grow plants in space and was achieved after the Spektr collision during the low-power period on Mir.

- Russian, Canadian and U.S. facilities aboard Mir have been used to perform experiments in fluid physics, combustion science, colloid science, metallurgy and diffusion of liquids such as metals heated in a furnace. The facilities included furnaces, a glovebox to contain experiments as required, and a system to isolate experiments from the station's vibration environment. Some experiments tested, verified or modified basic theories in fluid physics.

- The controlled combustion experiments provided a better understanding of how flames spread in space. Colloids, solid particles suspended in liquid, are seen in every day life as cosmetics, paints and other industrial products, and their study in weightlessness without the disturbing influence of gravity can lead to better commercial products here on Earth.

-more-

- The astronauts on Mir have substantially added to the growing database (about 300,000 images) of Earth observation photographs. During their months aboard the Mir, crew members have observed and recorded long-term and seasonal changes in various areas of interest. Agricultural patterns, global deforestation and drying up of lakes can be monitored over long periods of time. In addition, astronauts have observed and photographed rapidly occurring events such as volcanic eruptions and fires that otherwise may have gone unobserved.

- New findings about the South Atlantic Anomaly's northwestward migration have been published based on results from Mir, and a better understanding of the solar cycle has been made possible.

- Investigators preparing for the International Space Station program have learned a great deal from experiments monitoring the external environment of Mir which, in many cases, will be similar to the external conditions around the Space Station. Sensors placed on the outside of Mir have detected everything from micrometeoroids to leftover specks from spent rocket stages. The data also show that large detectable pieces of orbital debris in some cases may be accompanied by clouds of particles too small to detect, but that may also cause deterioration of solar panels and other external structures.

-end-

Video Advisory

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

For Release
September 17, 1997

Renee Juhans
Headquarters, Washington, DC
(Phone: 202/358-1712)

VIDEO ADVISORY: V97-91

MEN IN NASA SHADES; WE BRAKE FOR MARS

Today's video file shows sunglasses designed to help pilots and drivers to see our skies and roads better. Also on NTV is animation of NASA's Mars Global Surveyor performing aerobraking maneuvers.

ITEM 1: NASA'S NEW SHADES
Footage of the sunglasses designed using filter modification.

For more information contact Don Nolan-Proxmire at (202) 358-1983 or John Bluck at (650) 604-5026.

ITEM 2: BRAKING IN ORBIT
Animation of the Mars Global Surveyor.

For more information contact Doug Isbell at (202) 358-1753.

ITEM 3: FILE FOOTAGE OF MIR
Footage of space station Mir.

ITEM 4: REPLAY- DAVID WOLF TRAINING IN STAR CITY, RUSSIA

For more information contact Rob Navias at (281) 483-5111.

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

Date: Thu, 18 Sep 1997 16:24:30 -0400 (EDT)
From: NASANews@hq.nasa.gov
Subject: NASA Selects Contract for Agency-Wide Financial Management System
Sender: owner-press-release@lists.hq.nasa.gov
To: undisclosed-recipients:;

Sonja Alexander
Headquarters, Washington, DC
(Phone: 202/358-1761)

September 18, 1997

Jim Sahli
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-0697)

RELEASE: C97-l

NASA SELECTS CONTRACT FOR AGENCY-WIDE FINANCIAL MANAGEMENT SYSTEM

NASA has selected KPMG Peat Marwick LLP, Washington, DC, to implement an agency-wide financial management system.

This Integrated Financial Management (IFM) System consists of the following components: core financial, budget, executive information system, travel, time and attendance, procurement, and asset management. The contract also will include all hardware and software required by the IFM System as well as associated implementation and sustaining support services.

The contract is valued at $186.3 million. It includes fixed price options for the budget, procurement, travel, and time and attendance components and the sustaining support services. The contract also includes a level of effort ceiling and a ceiling for indefinite-quantity training classes. An unpriced option for asset management is also included.

Deployment of the IFM System will begin on October 1, 1998, and is expected to be completed no later than July 1, 1999. The contract will be managed by NASAÕs Goddard Space Flight Center, Greenbelt, MD.

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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Brian Welch
Headquarters, Washington, DC
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For Release

September 18, 1997

RELEASE: 97-206

ASTRONAUT MICHAEL FOALE'S STATUS REPORT FROM MIR

In an audio status report from the Mir space station, NASA astronaut Michael Foale summarized his spacewalking experience and scientific research. He also reiterated the importance of having an American astronaut on Mir as a precursor to the International Space Station, concluding:

"I'd like to summarize really why I think Dave Wolf should stay onboard space station Mir when I leave. Really I think it comes down to the fact that even though during this flight, in particular for me -- which has been one of the hardest things I have very attempted in my life --I have to remember what John F. Kennedy said when I was about four years old. Forgive me if I get it wrong, he said, 'We do not attempt things because they are easy, but because they are hard, and in that way we achieve greatness.'

"I believe out of this cooperation of America with Russia, which is not always easy, we are achieving some extremely great things, in sum, and in the big picture. And for these reasons I think I've really valued my time onboard space station Mir. I will always remember the last three or four months with great, great alacrity and nostalgia, I'm sure. I really count all that we are doing together, America and Russia, in space and this endeavor to be extremely valuable to future cooperation on the Earth in the future. Thank you very much.

- end -

Date: Fri, 19 Sep 1997 13:36:54 -0400 (EDT)
From: NASANews@hq.nasa.gov
Subject: First Global Ocean Color Images to Be Released Sept. 23
Sender: owner-press-release@lists.hq.nasa.gov
To: undisclosed-recipients:;

David E. Steitz
Headquarters, Washington, DC
(Phone: 202/358-1730)

September 19, 1997

Lynn Chandler
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-9016)

NOTE TO EDITORS: N97-67

FIRST GLOBAL OCEAN COLOR IMAGES TO BE RELEASED SEPT. 23

Dramatic new images of the world's oceans from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) instrument will be the focus of a press briefing at 1 p.m. EDT on Tuesday, Sept. 23. The briefing will be held at the Visitors Center auditorium of NASA's Goddard Space Flight Center, Greenbelt, MD. The global ocean color images from SeaWiFS will be used by researchers to study how human-induced and natural events affect the global biosphere.

Participants in the briefing will be:

Dr. Mary Cleave
SeaWiFs Project Manager, Goddard Space Flight Center

Dr. Charles McClain
SeaWiFs Project Scientist, Goddard Space Flight Center

Dr. Gene Feldman
SeaWiFs Data Systems Manager, Goddard Space Flight Center

Dr. Otis Brown
University of Miami, FL
Dean, Rosenstiel School of Marine and Atmospheric Sciences

Mr. John McCarthy
Orbital Sciences Corporation, Dulles, VA
SeaStar Program Manager

The briefing will be carried live on NASA Television, with two-way question and answer capability for media at participating NASA centers. NASA Television is available on GE-2, Transponder 9C at 85 degrees West longitude, with a frequency of 3880 Mhz, and audio of 6.8 Mhz.

-end-

Video Advisory

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release
September 19, 1997

Renee Juhans
Headquarters, Washington, DC
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VIDEO ADVISORY: V97-93

HEALTH TEST IN SPACE

Today's video file features animation of a NASA device that will monitor the health of the future International Space Station. The Space Portable Spectroreflectometer, scheduled to fly aboard the Space Shuttle Endeavour on the STS-86 mission, will measure the effects of space on spacecraft materials.

ITEM 1: HEALTH TEST
Animation of the testing device.

ITEM 1a: INTERVIEW- RALPH CARRUTH, NASA RESEARCHER, MARSHALL SPACE FLIGHT CENTER

ITEM 1b: INTERVIEW- DON WILKES, PRESIDENT, AZ TECHNOLOGY
For more information contact Michael Braukus at (202) 358-1979 or Steve Roy at (205) 544-6535.

ITEM 2: REPLAY- MIR FOOTAGE

ITEM 3: REPLAY- DAVID WOLF TRAINING IN STAR CITY, RUSSIA

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

Date: Fri, 19 Sep 1997 16:42:17 -0400 (EDT)
From: NASANews@hq.nasa.gov
Subject: Cassini Launch Rescheduled for Oct. 13
Sender: owner-press-release@lists.hq.nasa.gov
To: undisclosed-recipients:;

Don Savage/Doug Isbell
NASA Headquarters, Washington, DC
(Phone: 202/358-1547)

September 19, 1997

George Diller
Kennedy Space Center, FL
(Phone: 407/867-2468)

Mary Beth Murrill
Jet Propulsion Laboratory, Pasadena, CA
(Phone: 818/354-5011)

RELEASE: 97-207

CASSINI LAUNCH RESCHEDULED FOR OCT. 13

The launch of NASA's Cassini spacecraft aboard a U.S. Air Force Titan IVB rocket has officially been rescheduled on the Eastern Range for Monday, Oct. 13. The payload is now back at Complex 40 atop the Titan IV Centaur. The launch window for Cassini extends from 4:55 to 7:15 a.m. EDT.

Cassini is a joint NASA-European Space Agency (ESA) mission to Saturn, which is scheduled to arrive at the ringed planet in 2004 after more than six years of interplanetary travel. After arrival, the spacecraft will orbit Saturn for four years studying the gas giant planet, its rings and moons, and the ESA-built Huygens probe will descend to the surface of the giant moon Titan.

- end -

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release

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Headquarters, Washington, DC
(Phone: 202/358-1979)

September 22, 1997

Steve Roy
Marshall Space Flight Center, Huntsville, AL
(Phone: 205/544-0034)

RELEASE: 97-209

EFFECTS OF SPACE ENVIRONMENT ON MIR TO BE MEASURED WITH NEW DEVICE

A new NASA device to monitor the structural health of the future International Space Station will soon be on its way to the Russian space station Mir for testing.

The Space Portable Spectroreflectometer, a device for measuring the effects of the space environment on spacecraft materials, is scheduled to fly aboard the Space Shuttle Atlantis on the STS-86 mission. Launch is targeted for no earlier than September 25.

The device is designed to test spacecraft materials such as those being used to construct the International Space Station. NASA and its international partners are scheduled to begin on-orbit assembly of the Space Station in June 1998.

"The Spectroreflectometer is the first hand-held, battery-powered device of its kind," said principal investigator Ralph Carruth of NASA's Marshall Space Flight Center in Huntsville, AL. "It will allow astronauts to monitor and assess the condition of actual spacecraft surfaces, rather than relying on information gathered from samples of previous experiments."

During a spacewalk planned for later this year, Russian cosmonauts and a U.S. astronaut will use the device to measure how much energy can be absorbed by the thermal control coatings, or radiator surfaces, of the Mir space station. "Radiators, where excess heat is dumped from the space station, are a vital part of the spacecraft's cooling system," said Jim Zwiener, co-investigator for the device at Marshall. "If the radiators degrade, the cooling system degrades, so these are critical surfaces."

- more -

Measurements will be used to determine the deterioration of radiator surfaces caused by the space environment. "Also, in the vacuum of space, gases generated by -- and released from -- the spacecraft collect on the spacecraft's surfaces, resulting in contamination," said Zwiener. The gas deposits are visible as a discoloration of the spacecraft's white paint surfaces.

Measurements will be taken from four sites on Mir -- three on the core module and one on a smaller adjacent module. To take measurements, the device will be held against the space station's surface for approximately two minutes. "During tests, light consisting of wavelengths from near ultraviolet to infrared will be emitted by sources within the device," explained Carruth. "The device measures then how much of this light is reflected, which also indicates how much is absorbed and the extent of deterioration."

The device will display the measurements on a small screen, and the astronauts will read the information to researchers on the ground. "Following the spacewalk, more detailed information will be downlinked to the ground from the device via a computer aboard Mir," said Carruth.

The radiator surfaces of Mir are very similar to those being manufactured for the Russian components of the International Space Station. Based on ground testing, researchers have constructed models of expected surface deterioration for the future space station. "Comparisons of findings from this study with computer models will allow researchers to better predict and plan for the health of the International Space Station," said Carruth.

The experiment also will test the design of the measuring device. "Plans are to not only use the device to monitor the effects of the space environment on the surfaces of the International Space Station," said Carruth, "but it may also be used to monitor other spacecraft, such as the Hubble Space Telescope."

NASA's Space Environments and Effects Program at Marshall will also use information gathered from the experiment to enhance the development of advanced technologies in the area of space environments for future NASA missions.

The Space Portable Spectroreflectometer was built for NASA by AZ Technology, Inc., in Huntsville, AL.

- end -

News Release

National Aeronautics and
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Washington, DC 20546
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Dwayne Brown
Headquarters, Washington, DC
(Phone: 202/358-1726)

For Release
September 22, 1997

Keith Henry
Langley Research Center, Hampton, VA
(Phone: 757/864-6120)

RELEASE: 97-210

PANEL SELECTS NASA-DEVELOPED HIGH-PERFORMANCE AIRCRAFT MATERIAL FOR AWARD

A panel studying new technologies has chosen a NASA-developed, high-performance composite material as one of the 100 most technologically significant new products and processes of 1997.

Scientists at NASA's Langley Research Center, Hampton, VA, developed the material, a high-temperature resin called PETI-5. The composite was recently selected for use in a U.S. supersonic civil airliner expected to be built early in the next century.

A 75-member panel that studied new technologies on behalf of *Research and Development* magazine honored the material's development as part of the magazine's annual R&D 100 Awards world-wide competition. PETI-5 is short for PhenylEthynyl Terminated Imide and is the fifth formulation developed. An awards banquet and exhibits program will be held Sept. 25 at Chicago's Museum of Science and Industry, after which winning entries will be on public display.

"The PETI technology has already been transferred to industry with licensing agreements to four different companies. This demonstrates the significant advance in technology which has been accomplished," said Greg Manuel, technology transfer agent at Langley. The four companies are Culver City Composites, Culver City, CA; Cytec Engineered Materials, Havre de Grace, MD; Fiberite, Greenville, TX; and Imitec, Schenectady, NY. The agreements position each of the companies to support advanced composites for a future supersonic civil airliner.

-more-

Because of the material characteristics of PETI-5, it is the only material that meets the needs for future high-speed civil transports. This is the only market that licensees are looking at presently. Other markets may become viable as the quantity of material produced increases and the cost of the material decreases.

NASA and industry have teamed to develop the technology necessary to build an economically viable supersonic civil transport plane that will fly at 2.4 times the speed of sound, and carry approximately 300 passengers at a ticket price only 20 percent over comparable subsonic flights. This plane would halve the flight times from California to Japan.

Since currently available metals are either too heavy or cannot withstand the high temperatures created when flying this fast, composite materials made from graphite fibers and PETI-5 are necessary to both withstand the high temperatures and to make the plane strong enough and light enough to be economically viable.

The market potential of an adhesive or composite matrix resin for a fleet of supersonic civil transports could be several billions of dollars. There is also a significant market for non-aerospace applications which require the exceptional combination of properties provided by PETI-5, such as high performance automobile engine applications.

- end -

Video Advisory

National Aeronautics and
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For Release
September 23, 1997

Debbie Rivera
Headquarters, Washington, DC
(Phone: 202/358-1743)

VIDEO ADVISORY: V97-94

HIGH-FLYING, BIRD'S EYE VIEW OF EARTH'S OCEANS

Today's video file features dramatic color images of the world's oceans from the new satellite instrument called the Sea-viewing Wide Field-of-view Sensor (SeaWIFS). These new images will be used by researchers to study how human-induced and natural events affect the global biosphere.

ITEM 1: FIRST IMAGES
Images include a sequence of the Chesapeake Bay area.
ITEM 1a: SEASTAR SATELLITE - ANIMATION
This satellite carries the SeaWIFS instrument.
ITEM 1b: "SEEING" PHYTOPLANKTON - ANIMATION
Two pieces of animation that show "sunbeams" plunging through water.
ITEM 1c: ADDITIONAL BACKGROUND VIDEO
ITEM 1d: INTERVIEW - MARY CLEAVE, SEAWIFS PROJECT MANAGER
ITEM 1e: INTERVIEW - GENE FELDMAN, SEAWIFS OCEANOGRAPHER
ITEM 1f: INTERVIEW - CHUCK McCLAIN, SEAWIFS PROJECT SCIENTIST
For more information contact David Steitz at (202) 358-1730) or Wade Sisler (301) 286-6256.

ITEM 2: REPLAY - HEALTH TEST

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
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For Release

September 23, 1997

David E. Steitz
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Goddard Space Flight Center, Greenbelt, MD
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RELEASE: 97-211

FIRST GLOBAL OCEAN-COLOR IMAGES FROM NEW SENSOR SHOW PROMISE FOR CLIMATE, BIOLOGICAL STUDIES

Exciting ocean-color images from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) — the first readily available ocean-color data in more than ten years — should play a major role in studying the ongoing El Niño and in other global warming research.

The SeaWiFS data also is giving scientists their first continuous look at the global biosphere — the combination of living organisms and their environment. Ocean color is largely determined by the concentration of microscopic marine plants called phytoplankton. Accurately measuring phytoplankton concentration is important to climate change research and to local economic concerns such as commercial fishing.

"The images are more than we ever could have hoped for," said oceanographer Dr. Gene C. Feldman, who heads SeaWiFS's data processing team at the Goddard Space Flight Center, Greenbelt, MD. "Although originally designed to just study the oceans, we've also discovered a way of using it to study the land as well, and as a result, we can study the global biosphere for the very first time."

"The new images clearly show areas of coastal upwelling along the northwest U.S., Argentina and western South Africa. These upwelling events foster dramatic plankton blooms which are a critical source of food for major fisheries. The data will be extremely valuable for fisheries management," said Dr. Charles McClain, SeaWiFS Project Scientist.

SeaWiFS offers great potential for monitoring oceanic conditions that have serious, and often tragic, effects on human health. Coastal blooms of algae have been associated with cholera outbreaks around the world. Early detection of these blooms, and subsequent in-water sampling, may significantly reduce the impact of these outbreaks. Red tides, ocean dumping of organic and chemical waste, and perhaps even oil spills can be tracked with SeaWiFS data, Feldman said.

-more-

With SeaWiFS, NASA is leading an international collaboration of researchers. More than 300 scientists representing 35 countries have already registered to use the data. Thirty-eight ground stations spread over 18 countries will receive data from the spacecraft.

NASA also has developed a software package called the SeaWiFS Data Analysis System (SeaDAS) for scientists worldwide to process the data. More than 150 scientists have already been to Goddard to learn how to use this package. Another 79 scientists from 11 countries are signed up for SeaDAS training at the Center this fall.

The SeaWIFS instrument is aboard a commercially built and operated satellite called OrbView 2, owned by Orbital Sciences Corp., Dulles, VA. OrbView 2 was launched at 3 p.m. EDT Aug. 1, 1997, from Vandenberg Air Force Base, CA, aboard an Orbital Pegasus XL launch vehicle. The SeaWiFS mission is unlike many other NASA missions. NASA's SeaWiFS Project described the data they wanted to purchase without giving specific requirements for the spacecraft itself.

"It's a whole new way of doing business," said SeaWiFS Project Manager Dr. Mary Cleave.

The SeaWiFS instrument was built by Hughes/Santa Barbara Remote Sensing, Santa Barbara, CA, and is the only scientific payload on the SeaStar spacecraft, developed by Orbital Sciences Corp. NASA is buying the data and is providing it to researchers throughout the world.

SeaWiFS is a follow-on sensor to the Coastal Zone Color Scanner (CZCS), which operated aboard NASA's Nimbus-7 satellite from 1978-1986 and proved that satellite sensors could detect ocean-color from space. SeaWiFS improves on CZCS by providing global coverage every 48 hours, giving a more accurate determination of phytoplankton concentration.

Images from SeaWiFS are available from the World Wide Web at URL:

http://seawifs.gsfc.nasa.gov/SEAWIFS.html

The SeaWiFS program supports NASA's Mission to Planet Earth enterprise, a long-term coordinated research effort to study the Earth as a global system and the effects of natural and human-induced changes on the global environment. Using the unique perspective available from space, NASA is observing, monitoring and assessing large-scale environmental processes focusing on climate change.

-end-

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release

Sept. 23, 1997

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RELEASE: 97-212

NASA MANAGERS AWAITING SHUTTLE-MIR INDEPENDENT SAFETY REVIEWS RESCHEDULE PRE-LAUNCH PRESS CONFERENCE

NASA managers today held their launch minus two day mission management meeting at the Kennedy Space Center, FL where they reviewed the readiness of the launch of Atlantis on mission STS-86. At this time, no technical issues are being worked and the launch team is proceeding towards a launch on Thursday evening, Sept. 25 at 10:34 p.m. EDT.

Final approval for Atlantis' launch is awaiting the results of two external Mir safety reviews. Lt. General Thomas Stafford, USAF (Ret.) conducts an independent review before each Space Shuttle mission to Mir at the request of NASA Administrator Daniel S. Goldin. In addition, NASA also has asked Mr. A. Thomas Young to conduct an external assessment. Stafford and Young will separately brief the Administrator on their findings on Wednesday afternoon.

Since the independent review results will not be available until late Wednesday afternoon, the pre-launch press briefing by NASA senior managers has been rescheduled to Thursday, Sept. 25 at 11 a.m. EDT.

A countdown status briefing is scheduled for 10 a.m. EDT on Wednesday, Sept. 24.

- end -

News Release

National Aeronautics and
Space Administration

Washington, DC 20546
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Don Savage
Headquarters, Washington, DC
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For Release

September 24, 1997
EMBARGOED UNTIL 2 P.M. EDT

Tammy Jones
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-5566)

Ray Villard
Space Telescope Science Institute, Baltimore, MD
(Phone: 410/338-4514)

RELEASE: 97-213

HUBBLE SEES A NEUTRON STAR ALONE IN SPACE

Astronomers using NASA's Hubble Space Telescope have taken their first direct look, in visible light, at a lone neutron star. This offers a unique opportunity to pinpoint its size and to narrow theories about the composition and structure of this bizarre class of gravitationally collapsed, burned-out stars.

By successfully characterizing the properties of an isolated neutron star, astrophysicists have an opportunity to better understand the transitions matter undergoes when subjected to the extraordinary pressures and temperature found in the intense gravitational field of a neutron star.

The Hubble results show the star is very hot, and can be no larger than 16.8 miles (28 kilometers) across. These results prove that the object must be a neutron star, for no other known type of object can be this hot and small.

"This puts the neutron star uncomfortably close to the theoretical limit of how small a neutron star should be," says Fred Walter of the State University of New York (SUNY) at Stony Brook. "With this observation we can begin to rule out some of the many models of the internal structure of neutron stars." The observation results, made by Walter and Lynn Matthews (also of SUNY), are reported in the Sept. 25 issue of Nature magazine.

- more -

Neutron stars, which are created in some supernovae, are so dense because the electrons and protons that form normal matter have been squeezed into neutrons and other exotic subatomic particles. Neutron star matter is the densest form of matter known to exist. (Theoretically, a piece of neutron star surface weighing as much as a fleet of battleships would be small enough to be held in the palm of your hand.)

The Hubble observations, combined with earlier data, promise to help astronomers refine the mathematical description -- called the equation of state -- of the complex transformations matter undergoes at extraordinary densities not found on Earth. Equations of state are well understood for "everyday" matter such as water, which can transition between gaseous, liquid and solid states. But the behavior of matter under extreme temperature and pressure found on a neutron star is not well understood.

Several hundred million neutron stars should exist in our galaxy. However, all neutron stars now known have either been found orbiting other stars in X-ray binary systems or emitting machine-gun blasts of radio energy as pulsars (a class of neutron star). The neutron star seen by Hubble is not a member of a binary system, and is not known to pulse at X-ray or radio wavelengths (it has not been detected as a radio source). Pulsars are young neutron stars born with strong magnetic fields; non-pulsing neutron stars may be old, dead pulsars, with ages of more than a million years, or they may never have been pulsars. Only a few lone neutron star candidates have been pinpointed through X-ray observations, and this is the first optical counterpart to be identified.

The first clue that there was a neutron star at this location came in 1992, when the ROSAT (the Roentgen Satellite) found a bright X-ray source without any optical counterpart in optical sky surveys. It drew the attention of astronomers because objects this hot and bright, without counterparts at other wavelengths, are extremely rare.

Hubble's Wide Field Planetary Camera 2 was used in October 1996 to undertake a sensitive search for the optical object, and found a stellar pinpoint of light within only 2 arc seconds (1/900th the diameter of the Moon) of the X-ray position.

Astronomers haven't directly measured the neutron star's distance but fortunately the neutron star lies in front of a molecular cloud known to be about 400 light-years away in the southern constellation Coronae Australis.

Using the distance to the cloud as an upper limit, the astronomers calculated a diameter by next comparing the neutron star's brightness and color as measured by Hubble, along with X-ray brightness from the ROSAT and EUVE (Extreme Ultraviolet Explorer) satellites.

The object is brightest at X-ray wavelengths. In the two Hubble images, the object is brighter at ultraviolet wavelengths than at visible wavelengths. They concluded they are directly seeing an ultracompact surface sizzling at about 1.2 million degrees Fahrenheit.

To be so hot, yet so dim (below 25th magnitude in visual light) and relatively close to Earth, the object must be extremely small -- below the size of a white dwarf, a more common stellar cinder. A hot white dwarf at this magnitude would lie 150,000 light-years away (outside our galaxy), and have 1/70,000 as much X-ray emission.

The 16.8-mile diameter estimate comes from assuming the neutron star is at the farthest it can be, just in front of the obscuring "wall" of the molecular cloud. If instead the neutron star is significantly closer to us, say midway to the molecular cloud, it would be smaller still, and present an even bigger challenge to the theories of the equation of state of nuclear matter.

Although neutron stars in binary systems allow astronomers to measure their mass, which turn out to be consistent with theory, it's much harder for astronomers to estimate the diameter of the neutron stars. Since the neutron stars "feed" on their companion stars in these systems, the light does not come exclusively from the surface but from jets, disks and other phenomenon that occur around the star. This can lead to inaccurate size estimates.

Over the next year, planned observation with the Hubble will be used in an attempt to determine exactly how far away and how large the star is.

- end -

A photo and caption are available via the World Wide Web at URLs:

http://oposite.stsci.edu/pubinfo/PR/97/32.html and via links in
http://oposite.stsci.edu/pubinfo/Latest.html or http://oposite.stsci.edu/pubinfo/Pictures.html.
Images are available via the World Wide Web at
http://oposite.stsci.edu/pubinfo/gif/nscra.gif (GIF),
http://oposite.stsci.edu/pubinfo/jpeg/nscra.jpg (JPEG).

Image files also may be accessed via anonymous ftp from oposite.stsci.edu in /pubinfo: gif/nscra.gif (GIF) and jpeg/nscra.jpg (JPEG). Higher resolution digital versions (300 dpi JPEG) of the release photograph are available in /pubinfo/hrtemp: 97-32.jpg (color) and 97-32bw.jpg (black & white). Full resolution TIFF image is available in /pubinfo/tiff/1997/32.tif.

Video Advisory

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

For Release
September 25, 1997

Renee Juhans
Headquarters, Washington, DC
(Phone: 202/358-1712)

VIDEO ADVISORY: V97-96

A MIR LOOK; IMAGES FROM MARS

Today's video file provides footage taken by Astronaut Michael Foale showing the interior of Mir. Also on NTV are the latest images and animation returned from the Mars Pathfinder.

ITEM 1: INSIDE MIR
For more information contact Rob Navias at (281) 483-5111.
ITEM 2: LATEST PATHFINDER IMAGES
For more information contact Doug Isbell at (202) 358-1753.
ITEM 3: REPLAY - STS-86 CREW TRAINING
ITEM 3a: REPLAY - INTERVIEW - STS-86 COMMANDER JAMES D. WETHERBEE, HUNTINGTON STATION, NEW YORK
ITEM 3b: REPLAY - INTERVIEW - NASA ASTRONAUT MICHAEL J. BLOOMFIELD, LAKE FENTON, MICHIGAN
ITEM 3c: REPLAY - INTERVIEW - RUSSIAN COSMONAUT VLADIMIR GEORGIEVICH TITOV, SRETENSK, RUSSIA
ITEM 3d: REPLAY - INTERVIEW - NASA ASTRONAUT SCOTT E. PARAZYNSKI, PALO ALTO, CALIFORNIA AND EVERGREEN, COLORADO
ITEM 3e: REPLAY - INTERVIEW - CNES ASTRONAUT JEAN-LOUP J.M. CHRÉTIEN, LA ROCHELLE, FRANCE
ITEM 3f: REPLAY - INTERVIEW - NASA ASTRONAUT WENDY B. LAWRENCE, JACKSONVILLE, FLORIDA
ITEM 3g: REPLAY - INTERVIEW - NASA ASTRONAUT DAVID A. WOLF, INDIANAPOLIS, INDIANA
ITEM 4: REPLAY - MIR REPLACEMENT COMPUTER
ITEM 5: REPLAY - FILE FOOTAGE OF THE MIR SPACE STATION
ITEM 6: REPLAY - DAVID WOLF TRAINING IN STAR CITY, RUSSIA
ITEM 7: REPLAY - NEW SEAWIFS IMAGES

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.
NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

News Release

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

For Release

Michael Braukus
Headquarters, Washington, DC
(Phone: 202/358-1979)

September 25, 1997

RELEASE: 97-214

PANELS GIVE ASTRONAUT A "GO" FOR LAUNCH TO MIR

NASA has received concurrence from the final panels reviewing the safety of the Russian Mir space station to proceed with its plans to exchange U.S. astronauts on the orbiting outpost.

An independent task force, chaired by Lt. Gen. Thomas P. Stafford, USAF (Ret.), a former Gemini and Apollo astronaut, has reaffirmed NASA's internal reviews to proceed with the Sept. 25 Space Shuttle mission to replace Dr. Michael Foale with Dr. David Wolf on Mir.

"This careful and thorough review of the Shuttle-Mir mission analyzed risk, readiness and, foremost, safety," said NASA Administrator Daniel S. Goldin. "We move forward not only because it is safe, but for the important scientific and human experience we can gain only from Mir. As we prepare for the June 1998 launch of the first element of the International Space Station, nothing can beat the hands-on, real-time training aboard Mir."

Stafford's group conducts an independent external assessment before each Space Shuttle mission to Mir. The panel reviews and issues reports on the preparations for Shuttle-Mir missions and makes appropriate recommendations on Shuttle-Mir safety, training, operations, rendezvous and docking.

NASA also asked Mr. A. Thomas Young to conduct an additional external assessment. Mr. Young is a member of the National Academy of Engineering and recently retired Executive Vice President of Lockheed Martin and President and Chief Operating Officer of Martin Marietta Corp. Mr. Young's assessment also endorsed the safety process.

- more -

In addition to the Stafford panel, NASA conducted two separate internal reviews. NASA's Shuttle-Mir Program Office, led by its manager, astronaut Capt. Frank Culbertson, USN (Ret.), conducted a Flight Readiness Review (FRR) in which each major Shuttle-Mir system and component critical to the crew's safety and mission success was reviewed and determined ready for flight. This concluded with the Shuttle FRR, a separate comprehensive review of all aspects of Shuttle mission readiness conducted by NASA's Space Shuttle Program Office. This review was held on Sept. 12 and resulted in unanimous approval to proceed with Thursday's Shuttle launch to Mir.

Astronaut Col. Fred Gregory, USAF (Ret.), Associate Administrator of the Office of Safety and Mission Assurance, conducted another NASA review. In this review, Gregory gave his certification of the Shuttle-Mir flight safety as one of the key NASA management approvals prior to a Shuttle mission.

Atlantis is scheduled for launch on Sept. 25 at 10:34 p.m. EDT from the Kennedy Space Center, FL.

- end -

News Release

National Aeronautics and
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For Release

Don Savage/Doug Isbell
Headquarters, Washington, DC
(Phone: 202/358-1547)

September 25, 1997

Barbara McGehan
National Oceanic and Atmospheric Administration
Space Environment Center, Boulder, CO
(Phone: 303/497-6288)

RELEASE: 97-215

MODERATE SOLAR STORM EXPECTED TO HAVE FEW EFFECTS ON EARTH

The NOAA Space Environment Center (SEC) in Boulder, CO, using data from its GOES weather satellites and the U.S. Air Force network of optical and radio observatories, detected several moderate to large solar flares on Sept. 23 and 24. Scientists at NASA's Solar and Heliospheric Observatory (SOHO) mission operations center verified that these events did expel some solar material into the solar system. Forecasters at SEC expect the resulting geomagnetic storm to be in the minor category. It should impact the Earth late on Sept. 26, continuing through the next day.

According to SEC space forecaster Dave Speich, geomagnetic storms of this level usually produce a minor effect on low orbiting satellites, radio wave propagation and mineral surveying. Typically, these storms are accompanied by short periods of intense activity when severe storming may occur in the Earth's magnetic field. During these times, it is possible for pipelines and electrical transmission lines to be affected. However, no significant outages in services to the general public are expected.

"These are just moderate flares from a small active region on the Sun," said Dr. Bill Wagner, Solar Physics Discipline Scientist, Office of Space Science, NASA Headquarters, Washington, DC. "Based on our observations this week, we do not expect that the crews of the Mir space station and the Shuttle will experience any appreciable effects from the solar storm to their electronics and other systems."

more -

This solar storm also poses no additional health risks from radiation to the crews in space, according to the Space Radiation Analysis Group (SRAG) at NASA's Johnson Space Center, Houston, TX. NOAA space weather forecasters will notify the SRAG of any potential solar events that might warrant NASA's response to solar activity.

SOHO is a joint NASA/European Space Agency mission. Over the next four days NASA will be observing this event using the Polar, Geotail and Wind spacecraft, which are missions in the Internation Solar Terrestrial Physics Program.

Stills and movie images of the events on the Sun may be seen on the Internet at:

http://umbra.nascom.nasa.gov/eit/cme/#MORETON

- end -

Video Advisory

National Aeronautics and
Space Administration
Washington, DC 20546
(202) 358-1600

Renee Juhans
Headquarters, Washington, DC
(Phone: 202/358-1712)

For Release
September 26, 1997

VIDEO ADVISORY: V97-97

LAUNCHING TOWARD THE FUTURE

Today's video file features animation of the X-33 Advanced Technology Demonstrator in a launch and landing sequence. In the final X-33 Environmental Impact Statement, NASA is about to name its preferred launch and landing sites.

ITEM 1: X-33 ANIMATION

Footage of the X-33 prototype launch vehicle.

For more information contact Jim Cast at (202) 358-1779 or Dom Amatore at (205) 544-0031.

ITEM 2: REPLAY- INSIDE MIR

Video news file today at noon, 3, 6, 9 p.m. and midnight EDT.

NASA Television is available on GE-2, transponder 9C at 85 degrees West longitude, with vertical polarization. Frequency is on 3880.0 megahertz, with audio on 6.8 megahertz.

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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Jim Cast
Headquarters, Washington, DC
(Phone: 202/358-1779)

For Release
September 26, 1997

Dom Amatore
Marshall Space Flight Center, Huntsville, AL
(Phone: 205/544-0031)

RELEASE: 97-216

NASA ISSUES FINAL X-33 ENVIRONMENTAL STUDY, NAMES PREFERRED LAUNCH AND LANDING SITES

NASA today released the Final Environmental Impact Statement on the development and flight testing of the X-33 Advanced Technology Demonstrator. The study considers issues such as public safety, noise, impacts on general aviation and effects on biological and natural resources. In the document NASA named three preferred landing sites and one preferred launch site for the X-33. Seven sites were evaluated for potential use during the 14-month study.

The preferred launch site is located near Haystack Butte on the eastern portion of Edwards Air Force Base, CA. The preferred landing sites identified are Silurian Lake, a dry lake bed near Baker, CA; Michael Army Air Field, Dugway Proving Ground, UT; and Malmstrom Air Force Base near Great Falls, MT.

After 30 days NASA will issue a Record of Decision announcing if it intends to proceed with the X-33 flight test program as described in the environmental impact statement. That final decision will be based on technical, cost and schedule considerations in addition to environmental factors.

"The study determined that the overall predicted environmental impacts of X-33 were minimal at all sites considered," said Dr. Rebecca McCaleb, who headed the study. McCaleb is director of environmental engineering and management at NASA's Marshall Space Flight Center in Huntsville, AL. The study was prepared by a team of dozens of experts from NASA's Marshall and Kennedy space centers who studied the issues surrounding the X-33 program. The Department of Defense, the Office of Commercial Space Transportation within the Federal Aviation Administration and the Bureau of Land Management all cooperated in preparation of the document.

-more-

The 22-pound (10.5-kilogram) rover has survived 10 times longer than its primary mission design of seven days, while the lander has now been operating 2.5 times longer than it was originally expected to operate, according to Richard Cook, Mars Pathfinder mission manager.

Both vehicles are solar-powered, but carried batteries to conduct night-time science experiments and keep the lander warm during the sub-freezing nights on Mars. Normal usage has fully depleted the rover's non-rechargeable batteries, limiting it to daylight activities only. The lander battery, which packed more than 40 amp-hours of energy on landing day, performed perfectly during the 30-day primary mission, but is now down to less than 30 percent of its original capacity.

"We expected to begin seeing this type of degradation on both vehicles and, of course, designed both the lander and rover to operate without batteries altogether," Cook said. "If everything else continues to operate properly, we could continue conducting surface experiments for months."

About once every two weeks, the lander battery is used to perform some night-time science experiments, he added. The primary activity is acquiring meteorological data and images of morning clouds, as well as images of Mars' two small moons, Phobos and Deimos.

Despite the lack of battery power, the rover has continued taking successful spectrometer readings during the day. In the next two weeks, engineers will drive the vehicle back to a magnetic target on the ramp from which Sojourner first touched Martian soil.

"This analysis of the dust on the ramp magnet is a very important science measurement," noted Dr. Matthew Golombek, Mars Pathfinder project scientist. "The results should give us a clue about how all this magnetic dust was formed."

Recent images and movies from Mars Pathfinder activities continue to be posted to the Internet at the following URL:

http://marsweb.jpl.nasa.gov

The next media briefing on science results from Mars Pathfinder is tentatively scheduled for Wednesday, October 8, at 1 p.m. ET at JPL.

The Mars Pathfinder mission is managed by the JPL for NASA's Office of Space Science, Washington, DC. The mission is the second in the Discovery Program of fast track, low-cost spacecraft with highly focused science goals. JPL is a division of the California Institute of Technology, Pasadena, CA.

- end -

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For Release

Douglas Isbell
Headquarters, Washington, DC
(Phone: 202/358-1753)

September 26, 1997

Diane Ainsworth
Jet Propulsion Laboratory, Pasadena, CA
(Phone: 818/354-5011)

RELEASE: 97-217

MARS PATHFINDER ROVER EXITS ROCK GARDEN TO BEGIN LONG TREK

After 83 days of atmospheric, soil and rock studies, NASA's Mars Pathfinder is moving into extended mission activities that will take the rover on its longest trek yet, while the lander camera completes its biggest and best landscape panorama.

"The lander and rover performance continues to be nothing short of extraordinary," said Brian Muirhead, Mars Pathfinder project manager at NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA. "We have proven that we know how to design robust robots to operate in the hostile environment of Mars."

The rover has just completed its last alpha proton X-ray spectrometer study for a while, taking compositional measurements of a rock nicknamed Chimp, located just behind and to the left of an area scientists call the Rock Garden. Once data from the spectrometer have been retrieved, Sojourner will begin a 164-foot (50-meter) clockwise stroll around the lander to perform a series of technology experiments and hazard avoidance exercises.

Meanwhile, the Pathfinder lander camera is continuing to image the Martian landscape in full-resolution color as part of its goal to provide a "super panorama" image of the Ares Vallis landing site. Each frame of this panorama is imaged using 12 color filters plus stereo.

"The super pan will be our biggest and best imaging data product," Muirhead said. "It is made up of 1 gigabit (1 billion bits) of data, of which we've received more than 80 percent. Given our limited downlink opportunities, we should have the full image by the end of October."

-more-

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The Mars Pathfinder mission is managed by the JPL for NASA's Office of Space Science, Washington, DC. The mission is the second in the Discovery Program of fast track, low-cost spacecraft with highly focused science goals. JPL is a division of the California Institute of Technology, Pasadena, CA.

- end -

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National Aeronautics and
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For Release

Jennifer McCarter
Headquarters, Washington, DC
(Phone: 202/358-1639)

September 29, 1997

Jerry Berg
Marshall Space Flight Center, Huntsville, AL
(Phone: 205/544-0034)

RELEASE: C97-m

ASRI CHOSEN TO PROVIDE FABRICATION AND ASSEMBLY SERVICES AT MARSHALL SPACE FLIGHT CENTER

Al Signal Research, Inc. (ASRI) a small, minority-owned enterprise in Huntsville, AL, has been awarded a contract by NASA's Marshall Space Flight Center, Huntsville, AL, to provide hardware fabrication and assembly services and design and test services at the center beginning Oct. 1, 1997.

The contract will start with a one-year basic period followed by four one-year options which may be exercised at NASA's discretion. If all options are exercised, the contract would be worth as much as $75.3 million.

The work to be performed under the contract includes operation of a high-precision machine shop. Among the services to be provided are machining, sheet metal work, assembly, welding, electrical and electronics work, surface treatment, heat treating, dry-film lubrication, and multilayer insulation blanket fabrication.

Proposals for this work were solicited nationally. The procurement was handled under the Small Business Administration program limiting competition to qualified small and disadvantaged businesses. A total of 10 proposals were received. These services were previously provided by Native American Services of Huntsville.

-end-

NewsRelease

National Aeronautics and
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For Release

So

nja Alexander
Headquarters, Washington, DC
(Phone: 202/358-1761)

September 29, 1997

Susan Hendrix
Goddard Space Flight Center, Greenbelt, MD
(Phone: 301/286-7745)

Keith Koehler
Wallops Flight Facility, Wallops Island, VA
(Phone: 757/824-1579)

RELEASE: c97-n

COMPANY SELECTED FOR OPERATION AND MAINTENANCE OF FACILITIES AT WALLOPS FLIGHT FACILITY

NASA has selected H&H Consolidated, Incorporated of Arab, AL, for award of a $25.6-million facilities operations and maintenance contract at NASA's Wallops Flight Facility, Wallops Island, VA. This performance-based, cost plus award fee contract is for a period of one year effective Oct. 1, 1997 with four one-year options.

Services provided under this contract will include plumbing, electrical and mechanical support for all facilities and equipment located at Wallops. The contractor also will provide stand-by and remote off-site project support for rocket launches worldwide and minor construction and renovation of various buildings at Wallops.

-end-

Contract Announcement

National Aeronautics and
Space Administration

Washington, DC 20546
(202) 358-1600

For Release

September 30, 1997

Jennifer McCarter
Headquarters, Washington, DC
(Phone: 202/358-1639)

Linda Matthews-Schmidt
Johnson Space Center, Houston, TX
(Phone: 281/483-5111)

RELEASE: C97-o:

NASA AWARDS $68 MILLION CONTRACT TO ROTHE JOINT VENTURE

NASA has selected Rothe Joint Venture (RJV), San Antonio, TX, for award of a $68 million contract to provide manufacturing and calibration services to the Manufacturing, Materials and Process Technology Division of the Lyndon B. Johnson Space Center, Houston, TX.

Included in the contract services are engineering, machining, sheet metal fabrication, welding, non-metallic fabrication, electronic-unit fabrication, metrology calibration, and instrument repairs. The work will be performed at the Johnson Space Center.

The award of the new cost plus award fee/incentive fee contract included re-competition and consolidation of existing contract efforts. The incumbent contractors are Rothe Development, Inc., for the Central Shop Support Services, and Simco Electronics for the Instrument Calibration and Repair Services.

-end-

News Release

National Aeronautics and
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Washington, DC 20546
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Douglas Isbell
Headquarters, Washington, DC
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For Release

September 30, 1997

Franklin O'Donnell/Diane Ainsworth
Jet Propulsion Laboratory, Pasadena, CA
(Phone: 818/354-5011)

NOTE TO EDITORS: N97-70

NEXT SCIENCE BRIEFINGS SET FOR TWO MARS MISSIONS

New science findings from NASA's two active Mars missions will be presented in news briefings during the next week.

Scientists from the **Mars Global Surveyor** mission will discuss initial results from their investigations in a news briefing at Noon EDT on Thursday, Oct. 2. Global Surveyor entered orbit around Mars on Sept. 11.

Representatives of the science team on **Mars Pathfinder** will participate in a news briefing at 1 p.m. EDT on Wednesday, Oct. 8. After landing on Mars on July 4, Pathfinder's lander and rover are currently active during an extended mission.

Both briefings will originate from NASA's Jet Propulsion Laboratory, Pasadena, CA, and will be carried live on NASA Television. In the event that activities on the current Space Shuttle mission preempt Thursday's briefing, the Global Surveyor briefing will be held locally as scheduled and will be replayed later on NASA Television.

NASA Television is broadcast on GE-2, transponder 9C, C-Band, 85 degrees west longitude, frequency 3880.0 MHz, vertical polarization, with audio at 6.8 MHz.

- end -

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Headquarters, Washington, DC
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For Release

September 30, 1997

RELEASE: 97-221

NASA NAMES MINORITY CONTRACTORS OF THE YEAR

NASA has named two small firms as minority contractor and subcontractor of the year for their exceptional contributions to the nation's space program.

Dynacs Engineering Company, Inc., Clearwater, FL, was named NASA Small Disadvantaged Business Contractor of the Year and Micro Craft, Inc., Tullahoma, TN, Small Disadvantaged Business Subcontractor of the Year.

Dynacs Engineering Company, nominated by NASA's Johnson Space Center, Houston, TX, was recognized for providing complex technical and management support for the integration of Russian cooperative activities into the International Space Station Program. Dynacs provides systems engineering and integration for Phase 1 experiments and demonstrations, including experiment definition, subsystem evaluations, safety assessments, and Shuttle and Mir systems integration and verification planning. Dynacs Engineering was founded in 1985 by its current President and CEO, Dr. Ramen Singh.

Micro Craft, Inc. was nominated for Small Disadvantaged Business Subcontractor of the Year by Sverdup Technology, Inc., Huntsville, AL, a prime contractor to NASA's Marshall Space Flight Center, Huntsville, AL. Under a subcontract with Sverdup Technology, Inc., Micro Craft supports the Computers and Data Systems Division of the Astrionics Laboratory in the design and development of a Space Station Furnace Facility ground test system, X-ray calibration facility master-control computer, and data archival/retrieval system. Ms. Fran Folk Marcum is the Chief Executive Officer of the company, which was founded in 1958.

NASA also awarded three of its employees the Exceptional Achievement Medal for their significant support of the Agency's socio-economic business programs in the small business, technical, and procurement arenas. Recognized were Tom May, Jet Propulsion Laboratory, Pasadena, CA, and Steve Craig and Aloysius Hepp from the Lewis Research Center, Cleveland, OH.

-more-

In addition, four Centers were recognized for meeting or exceeding all of their negotiated small business goals for Fiscal Year 1996. They were the Ames Research Center, Mountain View, CA, the Stennis Space Center, Stennis Space Center, MS, the Lewis Research Center, Cleveland, OH, and the Jet Propulsion Laboratory, Pasadena, CA. Ken Szalai, Director, Dryden Flight Research Center, Edwards, CA, along with Hernandez Engineering, Inc., Houston, TX, and Reggie Williams, President, Procurement Resources, Inc., Atlanta, GA, received special recognition awards.